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137-58-1-1236

Translation from: Referativnyy zhurnal, Metallurgiya, 1958, Nr 1, p 166 (USSR)

AUTHORS: Gavranek, V. V., Bol'shutkin, D. N.

TITLE: Surface Hardening as a Means of Improving the Cavitation Resistance of Metals (Povysheniye kavitatsionnoy stoykosti metallov s pomoshch'yu uprochneniya poverkhnosti)

PERIODICAL: Tr. Khar'kovsk. politekhn. in-ta, 1957, Vol 9, pp 169-177

ABSTRACT: Study of the cavitation resistance of 1Kh13 and EI10 steels to machining of the surface layer has established that electric spark machining of the surface by chromium, stellite, and pobedite does not increase cavitation resistance. The chemical and heat treatment of nitriding substantially increases erosion strength, particularly when the hardened layer consists of the α phase and is of maximum thickness.

M. Sh.

1. Metals--Cavitation--Resistance 2. Metals--Hardening

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S/123/59/000/008/029/043
A004/A002

Translation from: Referativnyy zhurnal, Mashinostroyeniye, 1959, No. 8, p. 113, # 29418

AUTHORS: Gavranek, V. V., Fuks, M. Ya., Bol'shutkin, D. N.

TITLE: X-Ray Investigation of Cavitation Erosion of Metals

PERIODICAL: Tr. Khar'kovsk. politekhn. in-ta, 1958, Vol. 14, pp. 161-168

TEXT: By X-ray examination, using different methods, the authors investigated the cavitation strength of IX13 grade steel after oil-hardening at 1,000°C and tempering at 680°C. It was found that during the first period of cavitation action a breaking up of the crystals is taking place, while during continued testing the crystal size is stabilized. During the same period, the magnitude of stress of the second kind grows and again returns to its initial value. Those crystallites, located at the surface, are subjected to destruction which are less favorable oriented in relation to the effective stresses from cavitation. The indicated selective destruction is extinguished in the course of time, since the appearing surface relief promotes the destruction of

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X-Ray Investigation of Cavitation Erosion of Metals

crystallites already independently from orientation. Probably it is possible to increase the erosion resistance in the initial period of destruction by preliminarily producing a favorable structure in the surface layer of metal (e. g. by cold rolling). It is presumed that cavitation destruction of metals is not taking place owing to plastic deformation, accompanied by a distortion of the crystal lattice, but is similar to the process of impact brittle failure. Crystallites emerging at the surface are eliminated by way of "breaking off", where the following layer of crystallites is laid bare, which are also involved in the effective zone of impact stresses. There are 4 figures and 8 references.

F. M. A.

Translator's note: This is the full translation of the original Russian abstract.

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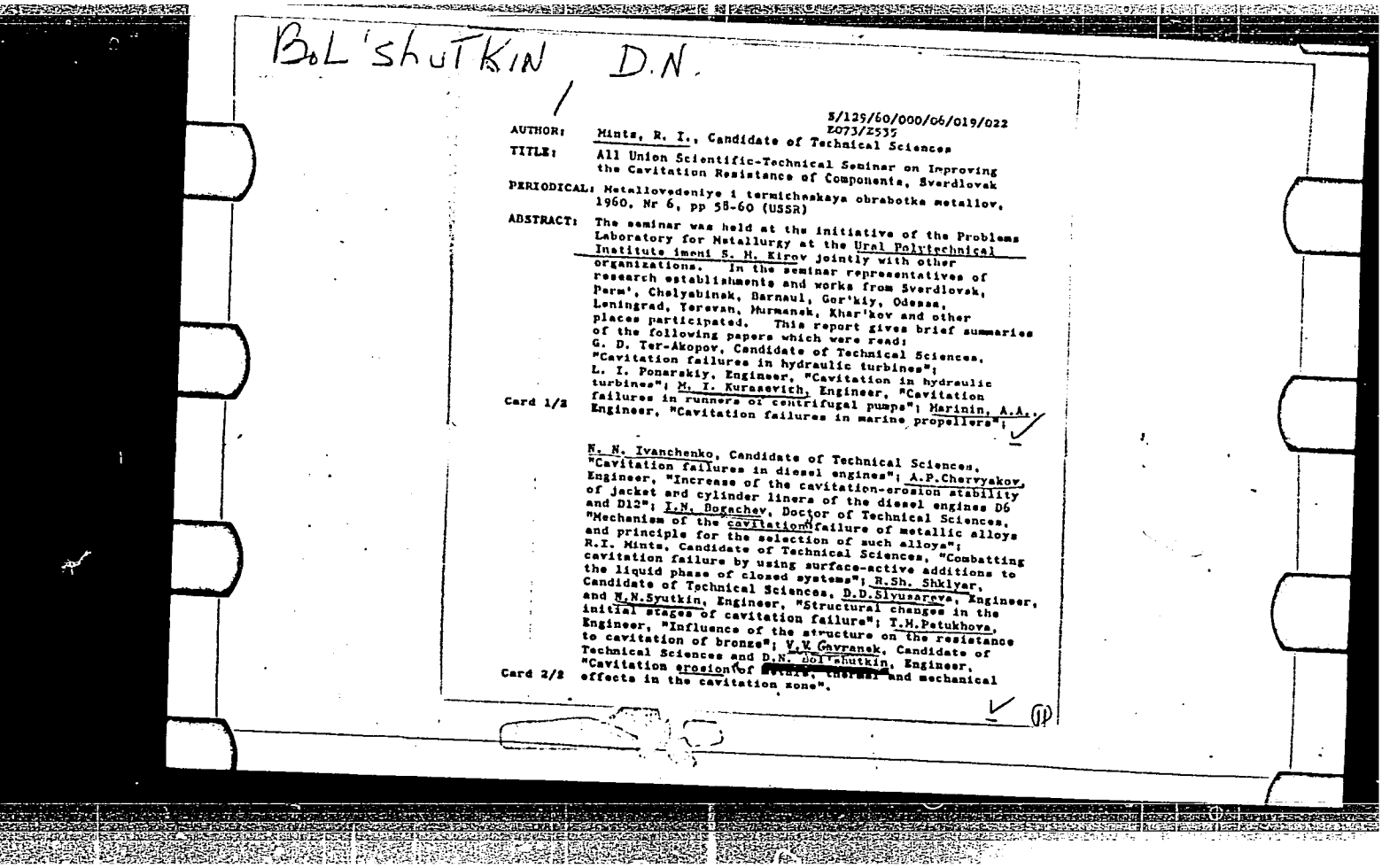

BOL'SHUTKIN D.N.

S/129/60/000/06/019/022
E073/E535

AUTHOR: Mints, R. I., Candidate of Technical Sciences

TITLE: All Union Scientific-Technical Seminar on Improving the Cavitation Resistance of Components, Sverdlovsk

PERIODICAL: Metallovedeniye i termicheskaya obrabotka metallov, 1960, Nr 6, pp 58-60 (USSR)

ABSTRACT: The seminar was held at the initiative of the Problems Laboratory for Metallurgy at the Ural Polytechnical Institute imeni S. M. Kirov jointly with other organizations. In the seminar representatives of research establishments and works from Sverdlovsk, Perm', Chelyabinsk, Barnaul, Gor'kiy, Odessa, Leningrad, Yerevan, Murmansk, Khar'kov and other places participated. This report gives brief summaries of the following papers which were read:
G. D. Ter-Akopov, Candidate of Technical Sciences, "Cavitation failures in hydraulic turbines";
L. I. Ponarskiy, Engineer, "Cavitation in hydraulic turbines"; M. I. Kurasovich, Engineer, "Cavitation failures in runners of centrifugal pumps"; Marinin, A.A., Engineer, "Cavitation failures in marine propellers";

Card 1/2

N. N. Ivanchenko, Candidate of Technical Sciences, "Cavitation failures in diesel engines"; A.P.Chervyakov, Engineer, "Increase of the cavitation-erosion stability of jacket and cylinder liners of the diesel engines D6 and D12"; I.N. Bogachev, Doctor of Technical Sciences, "Mechanism of the cavitation failure of metallic alloys and principle for the selection of such alloys"; R.I. Mints, Candidate of Technical Sciences, "Combatting cavitation failure by using surface-active additions to the liquid phase of closed systems"; R.Sh. Shklyar, Candidate of Technical Sciences, D.D.Slyusareva, Engineer, and N.N.Syutkin, Engineer, "Structural changes in the initial stages of cavitation failure"; T.M.Petukhova, Engineer, "Influence of the structure on the resistance to cavitation of bronze"; V.V.Gavrenek, Candidate of Technical Sciences and D.N. Bol'shutkin, Engineer, "Cavitation erosion of [redacted] thermal and mechanical effects in the cavitation zone".

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"APPROVED FOR RELEASE: 06/09/2000 CIA-RDP86-00513R000206130013-5

S/126/60/009/05/012/025
E021/E335

AUTHORS: Bol'shutkin, D.N., Gavranek, V.V. and Fuks, M.Ya.

TITLE: X-ray Investigation of Cavitation Erosion of Metals

PERIODICAL: Fizika metallov it metallovedeniye, 1960, Vol 9, Nr 5, pp 722 - 725 (USSR)

ABSTRACT: Materials used were the stainless steel 1Kh13 and an aluminium monocrystal. Cavitation tests were carried out using a magnetostriction vibrator of a frequency of 7.5 kc/s and 0.065 mm amplitude. Each sample was photographed twice by a sharp focusing X-ray camera, focusing the lines (110) and (220). Distribution of the influence of the breaking-up of the crystallites of the mosaic and the size of microstresses, on the diffuse lines, was found by the method of approximation and the method of harmonic analysis. It was shown that cavitation erosion occurred in a similar way to brittle fracture, which has been shown to occur, in the main, by breaking up of crystallites with no substantial microstresses. After cavitation erosion for up to 20 min, the (110) lines of the 1Kh13 steel sample showed the presence of an axial texture [110] normal to the surface of the sample. This

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X-ray Investigation of Cavitation Erosion of Metals

was produced by preferred disintegration of crystallites with a favourable orientation. Monochromatic and polychromatic radiations were used for the investigation of aluminium. Figure 1a shows the presence of misorientation of fragments of the monocrystal. Figures 1b and c show that in the initial stages of the test, intensive progressive granulation occurred in individual crystallite fragments. Calculations showed that after 45 sec, the surface was polycrystalline to a depth of 0.15 mm. No substantial microstresses were found. Investigations were also carried out on copper samples. The initial grain size was 150 μ and the grain size of the powder as a result of cavitation erosion was 5 μ. No substantial microdeformation was noted. The results explain the increased cavitation stability of fine-grained alloys. The phase changes occurring in the process of cavitation erosion in the steel U7 were also studied. It was found that tempering of the hardened steel occurred and local temperatures of 450 to 500 °C were reached. There are 4 figures and 4 Soviet references.

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E021/E335

X-ray Investigation of Cavitation Erosion of Metals

ASSOCIATION: Khar'kovskiy politekhnicheskiy institut imeni V.I. Lenina (Khar'kov Polytechnical Institute imeni V.I. Lenin)

SUBMITTED: July 25, 1959

n.b. This paper was presented at the Sixth All-Union Conference on Applying X-rays for Investigating Materials, June, 1958.

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"APPROVED FOR RELEASE: 06/09/2000 CIA-RDP86-00513R000206130013-5

Bol'shutkin, D.N.

S/126/60/010/01/010/019
E111/E335

AUTHORS: Gavranek, V.V., Bol'shutkin, D.N. and Zozulya, V.F.

TITLE: Microfractographic Investigation of the Cavitation Erosion of Metals

PERIODICAL: Fizika metallov i metallovedeniye, 1960, Vol. 10, No. 1, pp. 84 - 89

TEXT: The authors describe their use of the technique of micro-examination of fractured surfaces, previously used by some other investigators (Refs.1-3) in studies of alloy fracture, for getting information on cavitation erosion of metals. Changes in relief of eroded metal after cavitation tests of various durations and the influence of heat treatment and chemical composition on relief structure of alloys were studied. Annealed type 1Kh13 chromium stainless steel, type U7 carbon steel hardened to martensite structure and tempered for 1 hour at 100-600 °C, types Br.A2, Br.A4 and Br.A6 aluminium bronzes in the annealed state and types Br.A10, Br.A12 and Br.A13 in both annealed and hardened states were studied. Cavitation tests were made with a magnetostriction vibrator (Ref.4) at 75. cps in water. Micro-examination of eroded specimens was effected with the aid of

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Microfractographic Investigation of the Cavitation Erosion of Metals

titanium replicas (Ref 5). Photographs were obtained with a type EM-3 electron microscope at X1200. The characteristic appearance of brittle-fracture relief type 08KP steel and ductile fracture of chromium-nickel steel are shown in Figure 1 (left- and right-hand, respectively). Orientation and size of planes was also determined and compared with erosion speed (Ref. 6). Fig. 2 illustrates the surface relief of type 1Kh13 steel in the peripheral and central parts of the specimen and after a 3-minute test and the same after 90 minutes. The reliefs of type U7 steel specimens after tempering at 100, 400 and 600 °C and cavitation testing for 3 hours are compared in Figure 3 and those of Br.A2, Br.A6 and Br.A13 aluminium bronzes after 3-hours' cavitation testing in Fig. 4. The relief obtained with specimens of hardened Br.A10 and Br.A13 aluminium bronzes after 3-hours' testing is shown in Fig. 5. With the alloys studied cavitation erosion occurs by way of brittle fracture of crystals. The size and mutual orientation of planes from which crystals have broken away determine the erosion stability of the alloy; the smaller the planes and the

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Microfractographic Investigation of the Cavitation Erosion of Metals

degree of their disorientation the greater the stability. Stability can be increased either by hardening and tempering or by additional alloying. There are 5 figures, 1 table and 7 references: 5 Soviet and 2 French.

ASSOCIATION: Khar'kovskiy politekhnicheskiy institut im. V.I. Lenina (Khar'kov Polytechnical Institute im. V.I. Lenin)

SUBMITTED: September 16, 1959

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S/587/59/021/004/002/004
E091/E435

AUTHORS: Gavranek, V.V. and Bol'shutkin, D.N.

TITLE: X-ray investigation of cavitation erosion of monocrystals of aluminium

SOURCE: Khar'kov. Politekhnicheskiy institut. Trudy. v.21, no.4. 1959. Seriya metallurgicheskaya. 17-22

TEXT: It was found by V.V.Gavranek, M.Ya.Fuks and D.N.Bol'shutkin (Ref.1: Fizika metallov i metallovedeniye, 1955, v.1, no.3, 494) that erosion of metals under cavitation conditions is mainly the result of brittle fracture of crystals and that distortions of the crystal lattice caused by stresses of the second type develop only slightly in the initial stages of erosion. In order to obtain further information on the mechanism of cavitation destruction of materials, the authors investigated the structure of metallic monocrystals after they have been subjected to cavitation testing. Monocrystals of commercially pure Al were prepared by means of recrystallization annealing aluminium plates, 200 x 20 x 1 mm^3, which had first been deformed 3% in tension. Annealing was carried out at a temperature of 550°C, which was then raised to 590 and 630°C, the specimens being soaked at each temperature for

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X-ray investigation of ...

4 hours and subsequently furnace-cooled. As a result, monocrystals 70 x 20 x 1 mm^3 were obtained. Specimens for cavitation testing on a magnetostriction vibrator were cut from the monocrystal plates in the form of discs of 18 mm diameter. These were secured to a nickel tube by means of a special holder and subjected to cavitation testing in de-aerated tap water at 25°C for 15, 30, 45, 50, 90, 120 and 300 sec at a tube oscillation frequency of 7500 c/s and constant oscillation amplitude. X-ray pictures were taken of the specimens before and after testing. It was found that cavitation erosion of monocrystals of aluminium is accompanied by intense break-down of these crystals into fragments, so that already after 45 sec the surface of the specimens becomes polycrystalline to a depth of 0.15 mm, the grain size being 10^{-4} cm. It was also found that the cavitation destruction of Al monocrystals does not cause great lattice distortions of the second stress type. The authors express the opinion that the brittle destruction of metals under conditions of cavitation erosion may be due to propagation of stress waves created by the impact action of cavitation bubbles. There are 6 figures and 5 references: 4 Soviet and 1 Russian translation of an English book. The

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X-ray investigation of ...

reference to the English language publication reads as follows:
Ref.3: Barret, C.S., Structure of Metals. Russian translation
Metallurgizdat, 1948.

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"APPROVED FOR RELEASE: 06/09/2000 CIA-RDP86-00513R000206130013-5

BOL'SHUTKIN, D.N.; GAVRANEK, V.V.; FUKS, M. Ya.

X-ray investigation of the cavitation erosion of metals.
Fiz. met. i metalloved. 9 no.5:722-725 My '60. (MIRA 14:4)

1. Khar'kovskiy politekhnicheskiy institut imeni V.L. Lenina.
(Corrosion and anticorrosives)
(X rays--Industrial applications)

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Bol'shutkin, D.N.

82642
S/126/60/010/02/012/020
E021/E335

18.8200

AUTHORS: Gavranek, V.V., Bol'shutkin, D.N. and Zel'dovich, V.I.

TITLE: Thermal and Mechanical Action of a Cavitation Zone on the Surface of a Metal

PERIODICAL: Fizika metallov i metallovedeniye, 1960, Vol. 10, No. 2, pp 262 - 268

TEXT: The present work is an attempt to examine the change in temperature and pressure impulses arising in the surface layers of a solid in the cavitation zone. A magnetostriction vibrator was used in the experiments with a constant amplitude of 0.06 mm and a frequency of 7.5 kc/s. Phase changes in a quenched U7 steel and D1 duralumin were investigated in the cavitation zone by microhardness and X-ray investigations. Fig. 2 shows the relation of microhardness with time of cavitation erosion. Fig. 2a is for the steel and 2b for duralumin. The changes in hardness show that the temperature of micro-volumes during cavitation erosion reaches 470 °C. Fig. 3 shows the effect of a preliminary tempering treatment at various temperatures on hardness (Curve 2) and rate of erosion (Curve 1). The rate of erosion is practically unchanged by preliminary heat treatments

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Thermal and Mechanical Action of a Cavitation Zone on the Surface of a Metal

up to 400 °C. This shows that the damage occurs on micro-volumes of metal, the temperature of which is up to 400 °C. X-ray investigations show that the internal stresses arising in the steel in the process of quenching are removed by cavitation erosion. Similar results were obtained for duralumin. During the experiments, the duralumin became artificially aged, showing that high temperatures are reached during cavitation erosion.

The obtained results can be summarised thus:

1) the mechanical and the thermal effects in the cavitation zone produced by the magnetostriction vibrator were calculated. It was found that in the case of using a 7.5 kg/s vibrator, the pressure increases periodically to 550 kg/cm^2 during a period of about 10^{-5} sec and acts on an area of about 10^{-5} mm^2. The micro-volumes of the metal bordering on the cavitation bubble are heated to 300 - 500 °C.

2) It was established that during the process of cavitation erosion, hardened steel is being tempered at temperatures up

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Thermal and Mechanical Action of a Cavitation Zone on the Surface of a Metal

to 470 °C.

3) The speeds of cavitation erosion of steel hardened to obtain a martensitic structure and of steel tempered at temperatures below 400 °C are practically equal.

There are 4 figures and 10 Soviet references.

ASSOCIATION: Khar'kovskiy politekhnicheskiy institut im. V.I. Lenina (Khar'kov Polytechnical Institute im. V.I. Lenin

SUBMITTED: June 26, 1959, originally,
February 17, 1960, after revision.

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BOOK EXPLOITATION

PHASE I BOOK EXPLOITATION SOV/5511

Nauchno-tekhnicheskoye obshchestvo mashinostroitel'noy promyshlennosti.
Kiyevskoye oblastnoye pravleniye.

Metallovedeniye i termicheskaya obrabotka (Physical Metallurgy and Heat Treatment of Metals) Moscow, Mashgiz, 1961. 350 p. Errata slip Inserted. 5,000 copies printed.

Sponsoring Agency: Gosudarstvennyy nauchno-tekhnicheskiy komitet Soveta Ministrov USSR. Nauchno-tekhnicheskoye obshchestvo mashinostroitel'noy promyshlennosti. Kiyevskoye oblastnoye pravleniye.

Editorial Board: M. P. Braun, Doctor of Technical Sciences, I. Ya. Dekhtyar, Doctor of Technical Sciences, D. A. Dravgor, Doctor of Technical Sciences, I. S. Kamenetskiy, Engineer, Yu. A. Markovskiy, Candidate of Technical Sciences, V. G. Permyakov, Doctor of Technical Sciences, and A. V. Chernovol, Candidate of Technical Sciences; Ed.: K. S. Soroka; Tech. Ed.: M. S. Gorodetskaya; Chief Ed., Mashgiz (Southern Dept.): V. K. Serdyuk, Engineer.

Card 1/10

PURPOSE: This collection of articles is intended for scientific workers and technical personnel of research institutes, plants, and schools of higher technical education.

COVERAGE: The collection contains papers presented at a convention held in Kiyev on problems of physical metallurgy and methods of the heat treatment of metals applied in the machine industry. Phase transformations in metals and alloys are discussed, and results of investigations conducted to ascertain the effect of heat treatment on the quality of metal are analyzed. The possibility of obtaining metals with given mechanical properties is discussed, and are problems of steel brittleness. The collection includes papers dealing with kinetics of transformation, heat treatment, and properties of cast iron. No personalities are mentioned. Articles are accompanied by references, mostly Soviet.

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GAVRANEK, V.V.; BOL'SHUTKIN, D.N.

X-ray diffraction study of cavitation erosion of aluminum single crystals. Trudy KhPI 21 Ser.met. no.4:17-22 '59. (MIRA 14:7)

(Aluminum crystals--Testing)
(X rays--Diffraction)

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GAVRANEK, V.V., kand.tekhn.nauk, dotsent; BOL'SHUTKIN, D.N., kand.tekhn.nauk; VOLONTSEVICH, O.A., inzh.

Investigating the erosion strength of steel hardened by electric spark treatment and subjected to grinding. Vest.mashinostr. 43 no.9:62-64 S '63. (MIRA 16:10)

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BOL'SHUTKIN, P.N.; LEONT'YEVA, A.V.; SNIGIREV, V.G.; STARTSEV, V.I.

Hardness of crystalline methane. Fiz. tver. tela 7 no.9:2607-2611 S '65. (MIRA 18:10)

1. Fiziko-tekhnicheskiy institut nizkikh temperatur AN UkrSSR, Khar'kov.

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"APPROVED FOR RELEASE: 06/09/2000 CIA-RDP86-00513R000206130013-5

ACC NR: AP5022724 SOURCE CODE: UR/0181/65/007/009/2789/2792

AUTHOR: Bol'shutkin, D. N.; Prokhvatilov, A. I.; Sil'vestrova, T. V.; Startsev, V. I.

ORG: Physicotechnical Institute of Low Temperatures AN UkrSSR, Kharkov (Fiziko-tekhnicheskiy institut nizkikh temperatur AN UkrSSR)

TITLE: Mechanical properties of polycrystalline ammonia under unilateral compression

SOURCE: Fizika tverdogo tela, v. 7, no. 9, 1965, 2789-2792

TOPIC TAGS: ammonia, solid mechanical property, low temperature physics

ABSTRACT: The strength and ductility of polycrystalline ammonia are studied as functions of temperature under unilateral pressure. Cylindrical specimens 10 mm in diameter and 40 mm long with uniform microstructure and polished ends were studied at temperatures from 77 to 160°K. Curves are given for the breaking point, limit of proportionality and relative compression as functions of temperature. These data show that crystalline ammonia has extremely low strength properties and ductility. Solid ammonia is quite brittle at the temperature of liquid nitrogen and shows elastic deformation right up to the breaking point. At stresses of 0.5-0.6 kg/mm^2, cracks are formed parallel to the axis of the specimen with an accompanying characteristic

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sound and a slight reduction in loading (up to 100 g). The final breaking stress of ~0.8 kg/mm^2 remains constant throughout the experimental temperature range. At this point there is an instantaneous reduction in loading to zero and the specimen is shattered. The shape of the fragments and the slight degree of deformation before the breaking point show that cleavage is the mechanism responsible for fracture of ammonia crystals between 77 and 130°K. Above 130°K (0.6 T_m), the ductility of the specimens increases and creep is observed under a constant load. Shearing is responsible for fracture above this point since cleavage strength remains nearly constant with temperature, while an increase in temperature causes a considerable reduction in shearing strength. The relationship between rate of uniform creep V and stress σ is $V = A\sigma^n$, where A and n are constants equal to 500 and 5 respectively at 160°K and stresses greater than the limit of proportionality. The energy of creep activation is found to be 5.6 Kcal/mol. This is approximately 10% lower than the heat of sublimation for solid ammonia. Orig. art. has: 3 figures.

SUB CODE: 07,20/ SUBM DATE: 16Apr65/ ORIG REF: 005/ OTH REF: 010

APPROVED FOR RELEASE: 06/09/2000 CIA-RDP86-00513R000206130013-5"

"APPROVED FOR RELEASE: 06/09/2000 CIA-RDP86-00513R000206130013-5

L 26630-66 EWT(m)/EWP(w)/T/EWP(t) JD/JG

ACC NR: AP5025336 SOURCE CODE: UR/0126/65/020/003/0465/0467

AUTHOR: Bol'shutkin, D. N.; Krot, Yu. Ye.; Moskalenko, V. A.

ORG: Physico-Technical Low Temperature Institute AN USSR (Fiziko-tekhnicheskiy institut nizkikh temperatur AN USSR)

TITLE: Study of lanthanum and neodymium hardness as a function of temperature between 77°K and 293°K

SOURCE: Fizika metallov i metallovedeniye, v. 20, no. 3, 1965, 465-467

TOPIC TAGS: Lanthanum, neodymium, hardness, temperature dependence, cryogenic effect, phase transition, liquid nitrogen, induction furnace, vacuum furnace

ABSTRACT: The system studied consisted of 99.3% lanthanum containing 0.3% Ce; 0.1% Nd; 0.2% Pr; 0.02% Fe, and neodymium containing 99.2% neodymium and $< 0.5\%$ Pr, $< 0.1\%$ Sm, $< 0.002\%$ Ca, $< 0.05\%$ Fe. Samples were prepared in a vacuum induction furnace. Measurements of hardness were made by means of Vikker's apparatus equipped with a low temperature modification. Liquid nitrogen was used to obtain temperatures in the range of 77-293°K. A heater was attached for the evaporation of liquid nitrogen. It was found that 40% deformation at room temperature increased the hardness of both metals by 60% as compared to the

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L 26630-66

ACC NR: AP5025336

heated samples. Superimposed curves of lanthanum and neodymium show analogous temperature dependence for both metals.. By cooling these metals from 293 to 77°K their hardness increased by 50% for heat-treated samples and by about 40% for cold-worked samples. The absence of polymorphic transformations of lanthanum in the temperature range of 77°-293°K, regardless of its close resemblance to cerium, which has polymorphic transformations, was confirmed. Orig. art. has: 3 figs.

SUB CODE: 11,20,13/ SUBM DATE: 14Oct64/ ORIG REF: 002/ OTH REF: 002

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"APPROVED FOR RELEASE: 06/09/2000 CIA-RDP86-00513R000206130013-5

L 21396-66 EWT(m)/EWP(t) IJP(c) JD/WW/JW
ACC NR: AP6003800 SOURCE CODE: UR/0181/66/008/001/0248/0249

AUTHORS: Bol'shutkin, D. N.; Prokhvatilov, A. I.

ORG: Physicotechnical Institute of Low Temperatures AN UkrSSR, Khar'kov (Fiziko-tekhnicheskiy institut nizkikh temperatur AN UkrSSR)

TITLE: Temperature dependence of the moduli of elasticity of crystalline ammonia

SOURCE: Fizika tverdogo tela, v. 8, no. 1, 1966, 248-249

TOPIC TAGS: ammonia, temperature dependence, elastic modulus, elastic deformation, creep mechanism, stress relaxation

ABSTRACT: The authors used earlier compression-test data (FTT v. 7, 2789, 1965) to determine the static modulus of normal elasticity of polycrystalline ammonia in the temperature interval 77 -- 160K. Inasmuch as at T > 110K a great reduction is observed in the limit of proportionality of ammonia, making measurements on the deformation curve difficult, they made use of the fact that the proportionality limit can be increased by prior deformation of the samples. Conse-

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L 21396-66
ACC NR: AP6003800

quently the values of the modulus of normal elasticity were determined from the second-deformation curves the accuracy was 7 per cent. A plot of the temperature variation of the modulus of elasticity shows that the values of the dynamic modulus of normal elasticity differ little from the static modulus determined by the static method. With increasing temperature, the difference between the two increases from 14 per cent at 77K to 21 per cent at 160K, owing to the increased role of the relaxation processes and creep processes upon deformation of the crystalline ammonia. From the shear modulus of the crystalline ammonia, it is estimated that its theoretical strength is ~10 kg/mm^2. By comparison with the earlier results, it is concluded that the strength of the investigated polycrystalline ammonia was 15 times lower than theoretical. Orig. art. has: 1 figure and 2 formulas.

SUB CODE: 20/ SUBM DATE: 21Jul65/ ORIG REF: 002/ OTH REF: 003

Card 2/2 ULR

APPROVED FOR RELEASE: 06/09/2000 CIA-RDP86-00513R000206130013-5"

"APPROVED FOR RELEASE: 06/09/2000 CIA-RDP86-00513R000206130013-5

BOL'SHUKHIN, V.P.

Gramm equivalents and the problems on the normal concentration of solutions. Khim.v shkole 18 no.2:36-41 Mr-Ap '63. (MIRA 16:4)

1. Inzhenerno-stroitel'nyy institut, Leningrad.
(Chemistry--Problems, exercises, etc.)
(Solution (Chemistry))

APPROVED FOR RELEASE: 06/09/2000 CIA-RDP86-00513R000206130013-5"

"APPROVED FOR RELEASE: 06/09/2000 CIA-RDP86-00513R000206130013-5

ISAKOV, P.P.; SKARYTIN, L.I.; SHCHERBAKOV, V.A.; MAKARENKO, V.I.; BOL'SHUKHIN, V.S.; PIVNIK, M.M.; CHUDAKOV, V.D.; YAKOVLEV, G.S.;

[DET-250 diesel-electric tractor; its construction and operation] Dizel'-elektricheskii traktor DET-250; ustroistvo i ekspluatatsiia. Moskva, Mashinostroenie, 1965. 479 p. (MIRA 18:7)

APPROVED FOR RELEASE: 06/09/2000 CIA-RDP86-00513R000206130013-5"

"APPROVED FOR RELEASE: 06/09/2000 CIA-RDP86-00513R000206130013-5

BOL'SHUNOV, F.F., inzh.; SIDOROV, Ye.M.

Machine for mechanizing installation operations in railroad electrification. Transp. stroi. 12 no.9:18-21 S '62. (MIRA 16:2)
(Railroads--Electrification)

APPROVED FOR RELEASE: 06/09/2000 CIA-RDP86-00513R000206130013-5"

"APPROVED FOR RELEASE: 06/09/2000 CIA-RDP86-00513R000206130013-5

L 00736-66 EPF(c)/EWT(m) RM

ACCESSION NR: AP5022694 UR/0181/65/007/009/2607/2611

AUTHOR: Bol'shutkin, D. N.; Leont'yeva, A. V.; Snigirev, V. G.; Startsev, V. I.

TITLE: Hardness of crystalline methane

SOURCE: Fizika tverdogo tela, v. 7, no. 9, 1965, 2607-2611

TOPIC TAGS: hardness, methane, solid state

ABSTRACT: The authors study the effect of temperature on hardness and creep in polycrystalline methane at nitrogen and hydrogen temperatures. Since methane is actively dissolved by nitrogen and hydrogen, the specimens were prepared and their hardness was determined in the same hermetically sealed cryostat. The specimens were transparent without visible flaws and had a smooth horizontal surface. The hardness of the methane was determined by sinking a conical indenter into the specimen. The loading unit of the instrument consists of a metal cylinder with a weight of P = 600 g. On the lower section of the cylinder are three conical indenters with vertex angles of 90° located equidistantly around the cylinder. Penetration of the indenter was monitored on a cathetrometer with an accuracy of 0.01 mm. In determining the hardness, penetration of the indenter is given as $h = h_1 + h_2$ where h_1 is penetration under a load P_1 = 10 g, which is read on a spring indicator; h_2

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"APPROVED FOR RELEASE: 06/09/2000 CIA-RDP86-00513R000206130013-5

ACCESSION NR: AP5022694

is penetration of the indenter when the load is increased from 10 to 200 g. Since the hardness H, measured by the conical indenter, is independent of the load, then

$$H=\frac{P}{\pi h^2}=\frac{P_1}{\pi h_1^2}$$

and consequently

$$H=\frac{P}{\pi\left(\sqrt{\frac{P_1}{\pi H}}+h_2\right)^2},$$

from which the following relationship was derived for calculating the hardness

$$H=\frac{(\sqrt{P}-\sqrt{P_1})^2}{\pi h_2^2}.$$

The hardness of crystalline methane is given as a function of temperature in fig. 1 of the Enclosure. Curves for argon and krypton are given for comparison (C. Trepp, *Schweizer archiv.*, Bd. 24, 191, 230, 1958). A reduction in temperature was found to reduce the creep effect in solid methane. A physical explanation is given for the effect of temperature on hardness and creep on the basis of the dislocation

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"APPROVED FOR RELEASE: 06/09/2000 CIA-RDP86-00513R000206130013-5

L 00736-66

ACCESSION NR: AP5022694

theory. "In conclusion, the authors thank B. Ya. Sukharevskiy for help in the work and valuable advice, and V. Z. Bengus for consultation." Orig. art. has: 4 figures, 8 formulas, 1 table.

ASSOCIATION: Fiziko-tekhnicheskiy institut nizkikh temperatur AN UkrSSR, Kharkov (Physicotechnical Institute of Low Temperatures, AN UkrSSR)

SUBMITTED: 15Feb65 ENCL: 01 SUB CODE: SS

NO REF SOV: 003 OTHER: 005

Card 3/4

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L 00736-66

ACCESSION NR: AP5022694

ENCLOSURE: 01

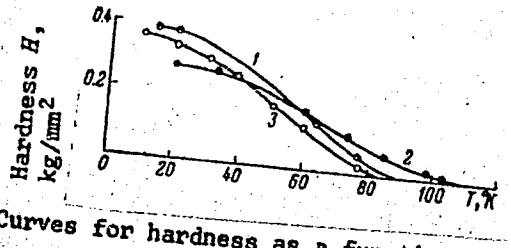

Fig. 1. Curves for hardness as a function of temperature in CH_4 (1); Kr (2); Ar (3).

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"APPROVED FOR RELEASE: 06/09/2000 CIA-RDP86-00513R000206130013-5

BOGUSH, A.A.; BOLSUN, A.I.

General calculation of the matrix elements for polarized vector particles. Dokl. AN SSSR 155 no. 5:1046-1049 Ap '64.
(MIRA 17:5)

1. Institut fiziki AN SSSR. Predstavleno akademikom V.A. Fokom.

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L 45656-65 EWT(m)/EWA(m)-2 Peb
ACCESSION NR: AP5009832 UR/0367/65/001/002/0288/0290

AUTHOR: Bogush, A. A.; Bolsun, A. I.; Satsunkevich, I. S. 19 16 B

TITLE: On the scattering of antineutrinos by electrons

SOURCE: Yadernaya fizika, v. 1, no. 2, 1965, 288-290

TOPIC TAGS: antineutrino scattering, electron scattering, form factor, vector meson, charge distribution, nonlocality parameter

ABSTRACT: The differential and total cross sections for the process $\bar{\nu}_e + e \rightarrow e' + \bar{\nu}'_e$, which has hitherto been discussed from the point of view of a weak contact interaction by several authors, are calculated in this paper by assuming the existence of intermediate vector mesons and by taking into account the possible charge distribution of the antineutrino. The possible information that can be obtained with existing experimental techniques is discussed, and possible methods of determining the nonlocality parameter due to the bosons and the Dirac charge form factor of the antineutrino are described. It is concluded that an account of the antineutrino charge form factor may be very important in the interpretation of experimental data on the process in question, and that if this form factor is small

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L 45656-65
ACCESSION NR: AP5009832

and the neutral vector meson does indeed exist, then the process may not be observable at all. "The authors thank F. I. Fedorov and L. G. Moroz for useful comments." Orig. art. has: 1 figure and 8 formulas.

ASSOCIATION: Moskovskiy inzhenerno-fizicheskiy institut (Moscow Engineering Physics Institute)

SUBMITTED: 01Jul64 ENCL: 00 SUB CODE: NP

NR REF SOV: 003 OTHER: 007

ml
Card 2/2

APPROVED FOR RELEASE: 06/09/2000 CIA-RDP86-00513R000206130013-5"

"APPROVED FOR RELEASE: 06/09/2000 CIA-RDP86-00513R000206130013-5

BOLʒUN, A.I.; SATSUNKEVICH, I.S.

Photoproduction of intermediate vector mesons on protons. Dokl. AN BSSR 8 no.11:705-708 N '64. (MIRA 18:3)

1. Institut fiziki AN BSSR.

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"APPROVED FOR RELEASE: 06/09/2000 CIA-RDP86-00513R000206130013-5

BOLSUN, A.I.

Photoproduction of pairs of polarized vector W-mesons.
Vestsi AN BSSR. Ser.fiz.-mat.nav.no.1:98-100 '65.
(MIRA 19:1)

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"APPROVED FOR RELEASE: 06/09/2000 CIA-RDP86-00513R000206130013-5

ACC NR: AP6030371 SOURCE CODE: UR/0428/66/000/001/0099/0106

AUTHOR: Bolsun, A. I.; Fedorov, F. I.

ORG: none

TITLE: Pseudoscalar matrix beta sub 5 and the electrical dipole moment of the W-meson

SOURCE: AN BSSR. Vestsi. Seryya fizika-matematychnykh navuk, no. 1, 1966, 99-106

TOPIC TAGS: meson, dipole moment

ABSTRACT: This paper, which was discussed at a seminar at the Theoretical Physics Laboratory, Institute of Physics, Academy of Sciences BSSR, shows that the β_5 matrix is necessary for the introduction of pseudovector interactions related to the internal electrical dipole moment (EDM) of a W-meson. The matrix and its properties, the EDM of the W-meson, and the effect of the latter on the processes $e^+ + e^- \quad W^+ + W^-$ are discussed in detail. The authors thank all who participated in the seminar at the Theoretical Physics Laboratory, Institute of Physics, BSSR, for the valuable discussions. Orig. art. has: 1 figure and 35 formulas. [JPRS: 35,668]

SUB CODE: 20 / SUBM DATE: 20Dec65 / ORIG REF: 007 / OTH REF: 010

Card 1/1

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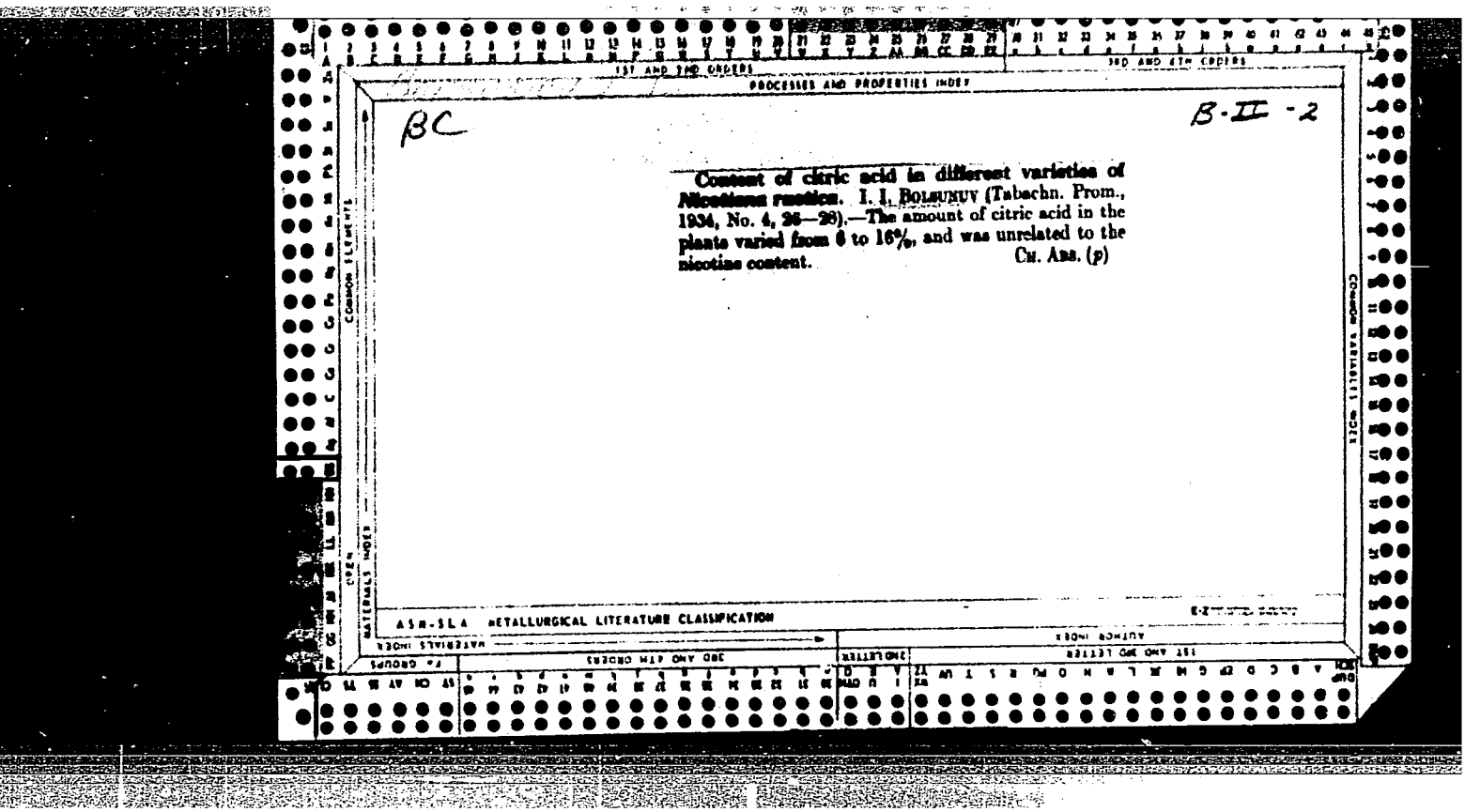

BC

B-II -2

Content of citric acid in different varieties of Nicotiana rustica. I. I. BOLSUNOV (Tabachn. Prom., 1934, No. 4, 26—28).—The amount of citric acid in the plants varied from 6 to 16%, and was unrelated to the nicotine content. CH. ABS. (p)

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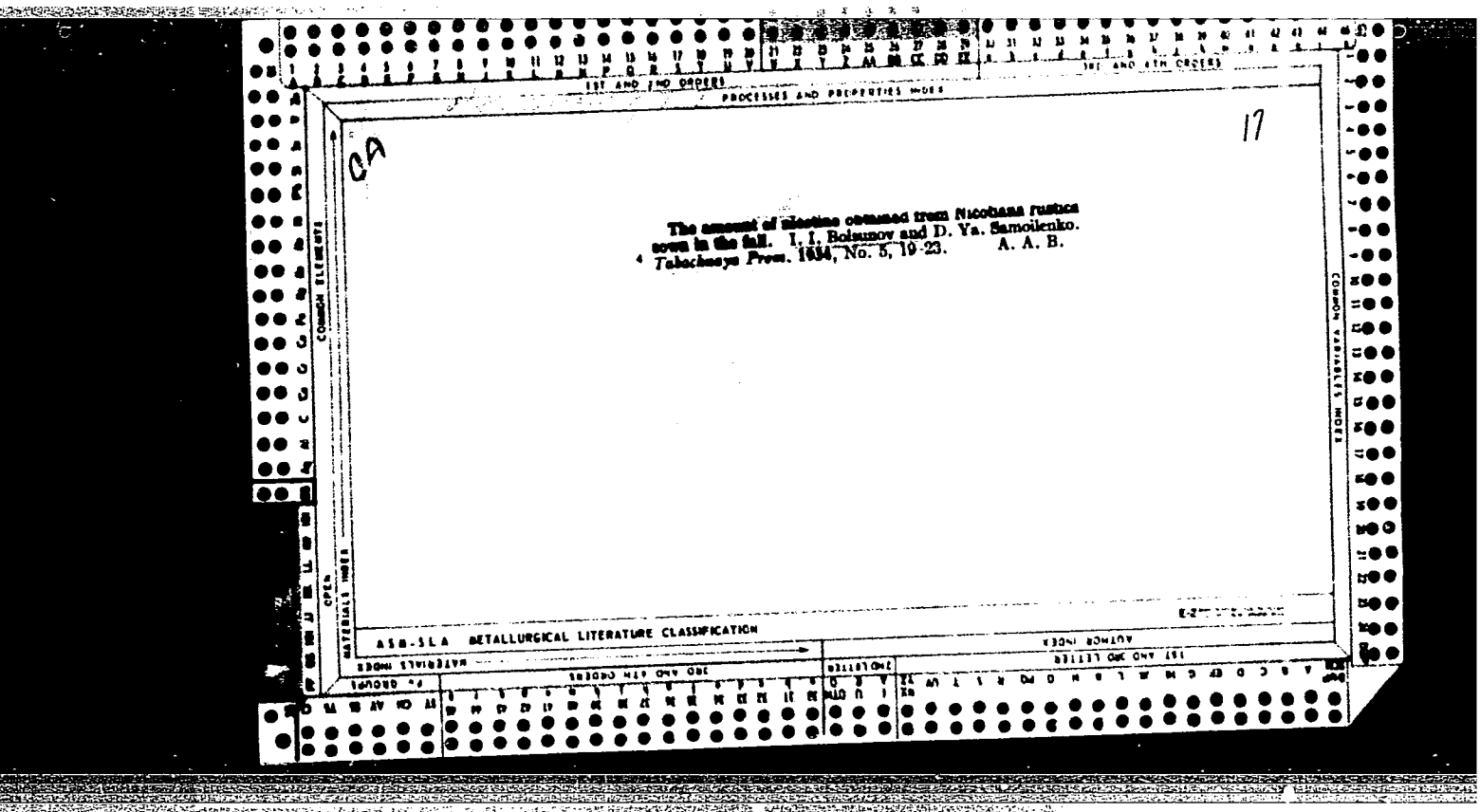

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"APPROVED FOR RELEASE: 06/09/2000 CIA-RDP86-00513R000206130013-5

BOLSUNOV, I. I.

"Selection of Nicotiana rustica and its progress" (p. 336) by Bolsunov, I. I.

SO: Advances in Modern Biology (Uspekhi Sovremennoi Biologie) Vol. XII, No. 2, 1940

APPROVED FOR RELEASE: 06/09/2000 CIA-RDP86-00513R000206130013-5"

"APPROVED FOR RELEASE: 06/09/2000 CIA-RDP86-00513R000206130013-5

Treatment of the stalk phloem in order to hasten the ripening process and to raise the sugar content of the leaves of Virginia Bright tobacco. Igor Bolsunov. *Fachliche Mitt. Österr. Tabakregie* 1955, No. 2, 1–13(English summary).—The effects of an annular decortication of the stalk of the tobacco plant were investigated. The results confirmed the earlier work and indicate a possible approach to the practical problem of improvement of quality of the leaf while the plants are still in the field. Working with large-leaved cigaret tobaccos, both air-cured and flue-cured (Virginia) types, decortication expts. were performed. Chem. analyses after curing showed that this treatment greatly increased the sugar content and decreased the nicotine and protein content of the leaves. In most cases the decortication resulted in an acceleration of the ripening of the leaves by 4–6 days, i.e., decompn. of chlorophyll had taken place. Furthermore, leaves harvested from plants, the stalks of which had been "phloem-treated," cured at a faster rate than did leaves harvested from control plants. The yield is somewhat reduced by this treatment of the stalk, especially with the upper leaves of the plant.

A. M. Gottscho

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"APPROVED FOR RELEASE: 06/09/2000 CIA-RDP86-00513R000206130013-5

PRUTSKOVA, M.G., kand. sel'khoz. nauk; UKHANOVA, O.I.; SAKHAROVA, L.I.; BOLSUNOVSKAYA, O.V.; IVANOVA, N.Ye.; LOVCHIKOV, I.S.; ZALKIND, G.N.; IL'IN, M.I.; KOZ'MINA, K.A.; SHIKUT', V.A.; PETROVA, Z.V.; GENERALOV, G.F.; BUDYUK, V.P.; GOMENYUK, L.I., red.

[New highly productive varieties of grain crops] Novye vysokoproduktivnye sorta zernovykh kul'tur. Moskva, Kolos, 1965. 319 p. (MIRA 18:8)

APPROVED FOR RELEASE: 06/09/2000 CIA-RDP86-00513R000206130013-5"

"APPROVED FOR RELEASE: 06/09/2000 CIA-RDP86-00513R000206130013-5

PRUTSKOVA, M.G., kand. sel'khoz. nauk; BOLSUNOVSKAYA, O.V., agronom; LOVCHIKOV, I.S., agronom; MARINICH, P.Ye., red.; KONDRATOVA, N.A., red.; PECHENKIN, I.V., tekhn. red.

[New strong and durum spring wheat varieties; Saratov 29, Saratov 210, Bezenchuk 98, Kharkov 46, Melianopus 26] Novye sorta sil'nykh i tverdykh iarovykh pshenits; Saratovskaia 29, Saratovskaia 210, Bezenchukskaia 98, Khar'kovskaia 46, Melianopus 26. Moskva, Izd-vo M-va sel'.khoz. SSSR, 1960. 73 p. (MIRA 14:8)

1. Russia(1923- U.S.S.R.) Gosudarstvennaya komissiya po sortoispytaniyu sel'skokhozyaystvennykh kul'tur. 2. Zamestitel' predsedatelya Gosudarstvennoy komissii po sortoispytaniyu sel'skokhozyaystvennykh kul'tur (Marinich)
(Wheat--Varieties)

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"APPROVED FOR RELEASE: 06/09/2000 CIA-RDP86-00513R000206130013-5

BOLSUNOVSKIY, L.I.

Using the laboratory outfit for radio engineering. Fiz. v shkole 20 no.5:82-83 S-O '60. (MIRA 13:11)

1. Pedagogicheskiy institut, g.Kremenets.
(Radio)

APPROVED FOR RELEASE: 06/09/2000 CIA-RDP86-00513R000206130013-5"

"APPROVED FOR RELEASE: 06/09/2000 CIA-RDP86-00513R000206130013-5

BOLSZAKOW, Zbigniew, mgr.inz.; BARJASZ, Wlodzimierz, mgr.inz.

The transistorized bridge type repeater. Przegl telekom 34 no.10:293-300 O '61.

APPROVED FOR RELEASE: 06/09/2000 CIA-RDP86-00513R000206130013-5"

"APPROVED FOR RELEASE: 06/09/2000 CIA-RDP86-00513R000206130013-5

ASHIKHMIN, A.D.; BOLTACHEV, G.M., veterinarnyy fel'dsher

Treating sheep during botfly infestations. Veterinariia 36 no.1:43-44 Ja '59. (MIRA 12:1)

1. Zaveduyushchiy veterinarnym uchastkom, Krasnogorskiy rayon, Udmurtskaya ASSR (for Ashikhmin).
(Sheep--Diseases and pests) (Botflies)

APPROVED FOR RELEASE: 06/09/2000 CIA-RDP86-00513R000206130013-5"

"APPROVED FOR RELEASE: 06/09/2000 CIA-RDP86-00513R000206130013-5

BOLTAK, V. (Yuzhno-Sakhalinsk)

Thank you, Sakhalin firemen! Pozh.delo 7 no.3:23 Mr '61.
(MIRA 14:5)

(Yuzhno-Sakhalinsk--Lifesaving at fires)

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"APPROVED FOR RELEASE: 06/09/2000 CIA-RDP86-00513R000206130013-5

BOLTAKS, A.I.

Organization of practical laboratory work in the measurement of certain meteorological elements. Meteor.i gidrol. no.5:60-61 My '53. (MLRA 8:9)

1. Vyssheye arkticheskoye morskoye uchilishche im. admirala S.O.Makarova, Leningrad.

(Meteorology)

APPROVED FOR RELEASE: 06/09/2000 CIA-RDP86-00513R000206130013-5"

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1000 BOLTAKS, B.I.

Physical properties of intermetallic compounds (Mechanism of the electric conductivity of Mg_3Sb_2). B. I. Boltaks and V. P. Zhuze (Leningrad Phys.-Tech. Inst.). *Zhur. Tekh. Fiz.* 18, 1459–77(1948); cf. following abstr.—Mg_3Sb_2 was investigated as a representative of the class of intermetallic compds. with normal valency of the elements and well-defined single compn., permitting deviations from stoichiometry only within a relatively narrow range. The alloys were prepd. by fusion of the elements under N_2 or A, with slow rise of the temp. to 1400–500° during 8–10 hrs., slow cooling during 6–8 hrs., and 10–12 hrs. annealing at 500–600°; the samples obtained were coarsely polycryst. (attempts to grow single crystals in conical tubes were unsuccessful). A series of samples cut out from ingots differed by an excess of either Sb or Mg over the stoichiometric compn. (Sb 77, Mg 23%): (I) Sb 78.7, Mg 21.3% (Sb excess, 7.5%), (II) 72.0, 28.0 (Mg, 6.3), (III) 73.8, 26.2 (Mg, 4.0), (IV) 74.5, 25.5 (Mg, 3.1), (V) 76.2, 23.8 (Mg, 0.9), (VI) 76.8, 23.2 (Mg, 0.2) (annealed 24 hrs. at 600°), (VII) 77.4, 22.6 (Sb, 1.9), (VIII) 75.35, 24.65 (Mg, 1.77). The elec. cond. σ increases very strongly with the deviation from stoichiometric compn.; at 20°, for the above samples, σ = 51.2, 6.4, 0.41, 0.025, 0.00081, 0.032, 7.85, 0.56 ohm^{-1} cm^{-1}. More-prolonged annealing increases σ roughly by a factor of 10, but leaves the temp. coeff. $d\sigma/dT$ unchanged; subsequently repeated heating and cooling does not change σ any further. The temp. dependence of σ (measured between −160 and +350°, occasionally to +600°) of different samples varies within wide limits, with respect to both magnitude and sign. Poorly conducting samples have a low pos. temp. coeff. of σ at low temps., but at higher temps. σ increases exponentially with the temp., as in typical semiconductors; in that high-temp. range, log σ is a linear function of $1/T$. The width ΔE of the forbidden zone, from the slope of the high-temp. log σ, $(1/T)$ plots, is V 0.47, VI 0.43 e.v.; ΔE varies from 0.36 to 0.72 e.v. At low temps., the 1st (impurity) term in $\sigma = A_1 e^{-\Delta E_1/2kT} + A_2 e^{-\Delta E/2kT}$ (with $A_1 = 2 \times 10^{-3} - 4 \times 10^{-3}$, $\Delta E_1 = 0.05 - 0.10$ e.v.) is significant over the 2nd (intrinsic) term. By electrolysis expts. at 20 and at 350°, the contribution of ionic cond. is certainly less than 0.1%. The Hall const. R is pos. throughout, and decreases with increasing temp. in all samples; the slope of the log R, $(1/T)$ plot is small at low temps., and larger at higher temps. With further rising temp., R tends to zero, for about 800–1000°; in that range, the alloy becomes an intrinsic semiconductor. In the low-temp. range, ΔE_2 from the Hall effect varies between 0.01 and 0.05 e.v., and in the high-temp. range ΔE varies between 0.52 and 0.69 e.v., i.e. in good agreement with the values derived from σ. The pos. sign of R corresponds to hole cond. On the uncertain assumption of only one kind of carrier, the mean free path at 20° is estd. to be $(1.2 - 3.0) \times 10^{-6}$ cm. Carrier mobilities estd. on the same basis are very widely scattered, ranging from 0.01 to 50 cm./v./cm.; this scattering is taken to indicate mixed carriers. By detns. of the thermoelec. e.m.f. (against Cu), most samples were found to be hole conductors, and only a few electronic conductors. Low-cond. samples (of σ = 0.00002 − 0.0008 ohm^{-1} cm.$^{-1}$) showed a thermoelec. e.m.f. α decreasing with increasing temp. in conformity with the theoretical formula for semiconductors with only one kind of charge carrier; the value of ΔE from the temp. dependence of α is in agreement with the order of magnitude derived from σ and from R. The theoretical formula is in good agreement with the measurements at higher temps.; at lower temps., the exptl. α are

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USSR/Physics
Magnetic Susceptibility
Magnesium Alloys

Feb 49

"The Magnetic Susceptibility of the Semimetallic Compound Mg_2Sn," B. I. Boltaks, Leningrad Physico-tech Inst, Acad Sci USSR, 3 pp

"Dok Ak Nauk SSSR" Vol LXIV, No 4

Magnetic characteristics of a substance depend on the degree of ionization of atoms in its lattice-work, and, knowing these, several conclusions may be made on the nature of the bond. Used this principle to state that the relation of magnetic

PA 27/49T98

USSR/Physics (Contd)

Feb 49

susceptibility to temperature confirms the assumption on the mixed heteropolar-metallic character of the bond in the semimetallic compound Mg_2Sn. Submitted 26 Nov 48.

BOLTAKS, B. I.

27/49T98

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PA 29/49T6

BOLTAKS, B. I.

USSR/Chemistry - Magnesium Alloys, Tin Feb 49
Chemistry - Electroconductivity

"Electrical Character of Intermetallic Bond of Mg_2Sn," B. I. Boltaks, 4 pp

"Dok Ak Nauk SSSR" Vol LXIV, No 5

Attempts to supplement material available on electroconductivity of Mg_2Sn by presenting data on dependencies of electroconductivity, thermoelectromotive force, and Hall's effect upon temperature. Submitted by Acad A. F. Ioffe, 26 Nov 48.

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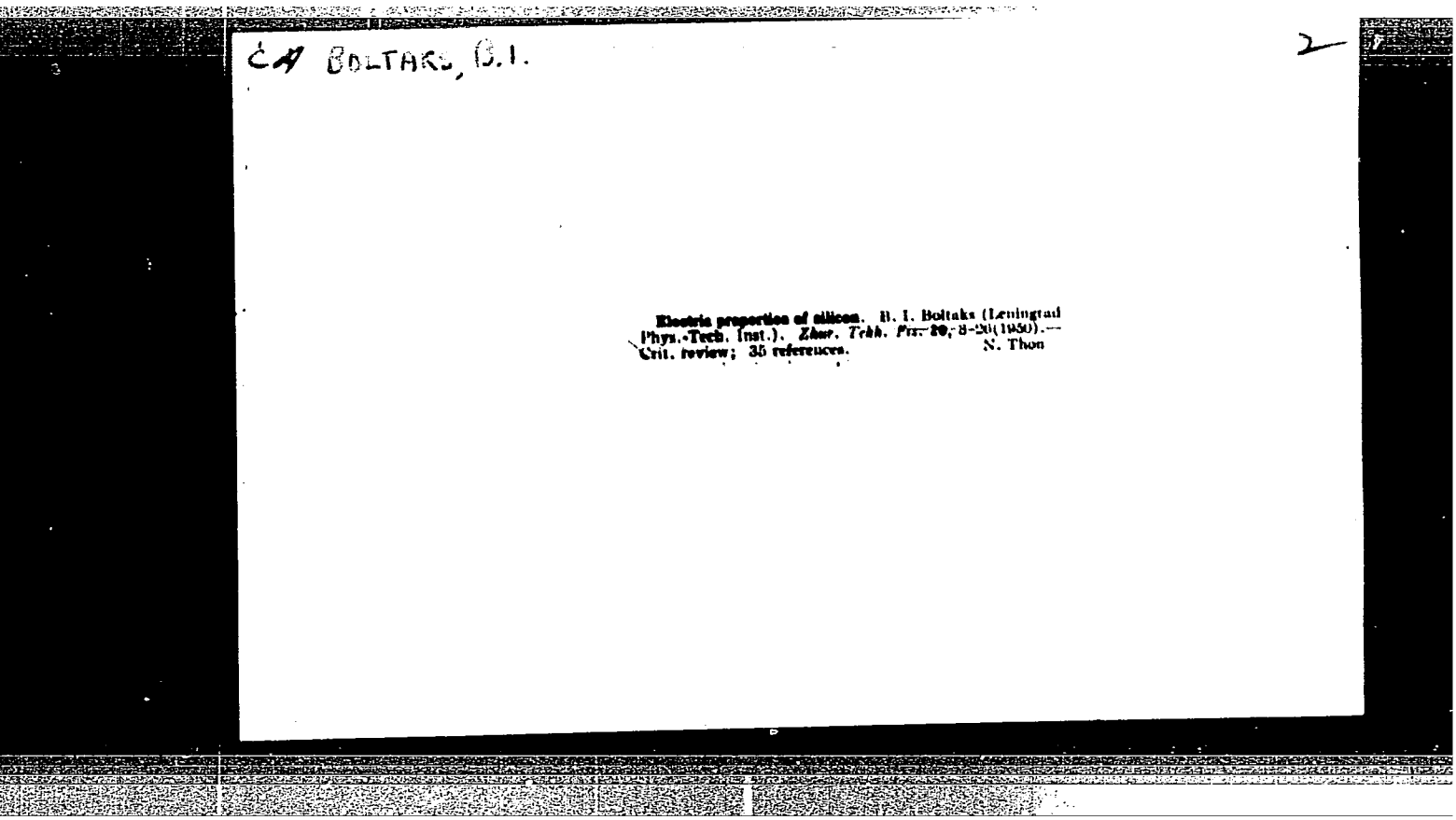

CA BOLTAKS, B.I.

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Electric properties of silicon. B. I. Boltaks (Leningrad Phys.-Tech. Inst.). *Zhur. Tekh. Fiz.* 20, 8-30(1950).—Crit. review; 35 references. N. Thon

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USSR/Physics - Magnetic Susceptibility Feb 50
Intermetallic Compounds

"Nature of the Electrical Properties and Magnetic Susceptibility of the Intermetallic Compound Mg_2Sn," B. I. Boltaks, Leningrad Physicotech Inst, Acad Sci USSR, 13 pp

"Zhur Tekh Fiz" Vol XX, No 2

Studies dependence upon temperature of specific electrical conductivity, Hall constant, thermo-emf and magnetic susceptibility of intermetallic compound Mg_2Sn. On basis of electrical properties studied, concludes Mg_2Sn must belong to class of admixed semiconductors. From data on temperture behavior of magnetic susceptibility, makes conclusion on composite (mixed) heteropolar and metallic character of bond in this compound. Submitted 21 Jul 49.

156T103

BOLTAKS, B. I.

PA 156T103

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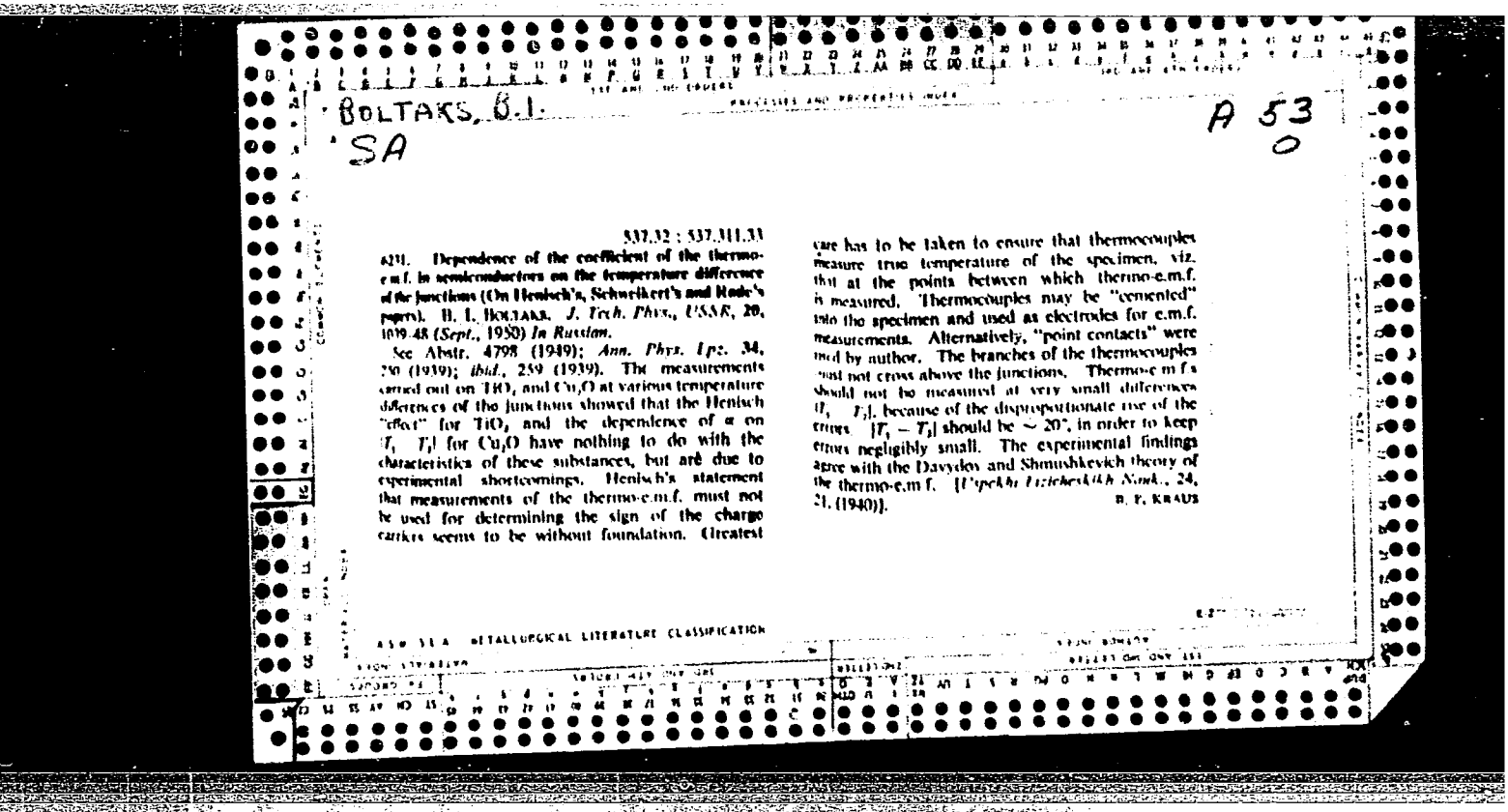

BOLTAKS, B.I.
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4291. **Dependence of the coefficient of the thermo-e.m.f. in semiconductors on the temperature difference of the junctions (On Henisch's, Schweikert's and Rode's papers).** B. I. BOLTAKS. *J. Tech. Phys., USSR*, 20, 1039-48 (*Sept.*, 1950) *In Russian.*

See Abstr. 4798 (1949); *Ann. Phys. Lpz.* 34, 250 (1939); *ibid.*, 259 (1939). The measurements carried out on TiO, and Cu_2O at various temperature differences of the junctions showed that the Henisch "effect" for TiO_2 and the dependence of α on $|T_1 - T_2|$ for Cu_2O have nothing to do with the characteristics of these substances, but are due to experimental shortcomings. Henisch's statement that measurements of the thermo-e.m.f. must not be used for determining the sign of the charge carriers seems to be without foundation. Greatest care has to be taken to ensure that thermocouples measure true temperature of the specimen, viz. that at the points between which thermo-e.m.f. is measured. Thermocouples may be "cemented" into the specimen and used as electrodes for e.m.f. measurements. Alternatively, "point contacts" were used by author. The branches of the thermocouples must not cross above the junctions. Thermo-e.m.f.s should not be measured at very small differences $|T_1 - T_2|$, because of the disproportionate rise of the errors. $|T_1 - T_2|$ should be $\sim 20°$, in order to keep errors negligibly small. The experimental findings agree with the Davydov and Shmushkevich theory of the thermo-e.m.f. (*Uspekhi Fizicheskikh Nauk.*, 24, 21 (1940)).

B. F. KRAUS

A S M V E A METALLURGICAL LITERATURE CLASSIFICATION

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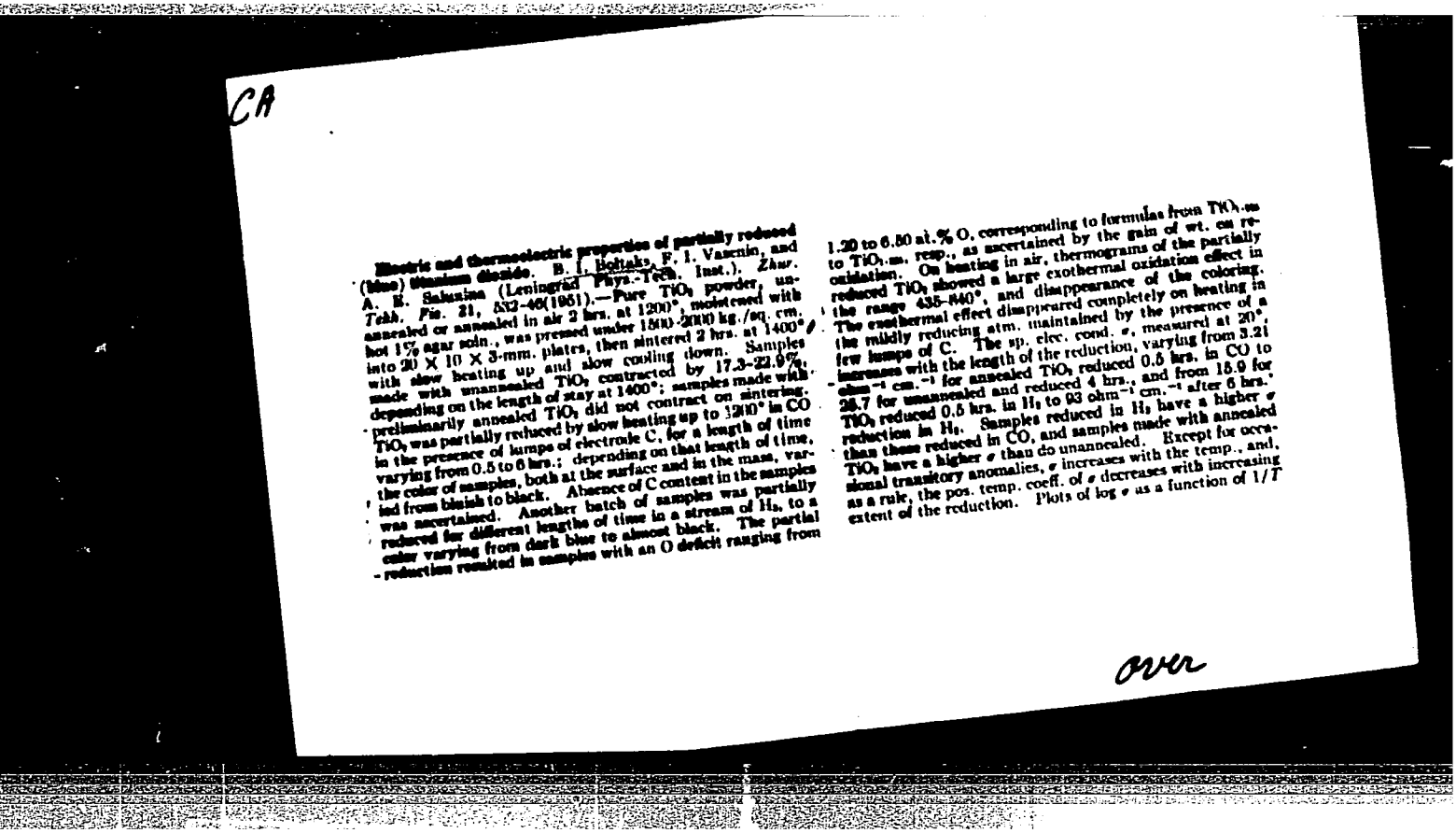

CA

Electric and thermoelectric properties of partially reduced (blue) titanium dioxide. B. I. Boltaks, F. I. Vasenin, and A. E. Saksina (Leningrad Phys.-Tech. Inst.). *Zhur. Tekh. Fiz.* 21, 832-46(1951).—Pure TiO_2 powder, unannealed or annealed in air 2 hrs. at 1200°, moistened with hot 1% agar soln., was pressed under 1500-2000 kg./sq. cm. into 20 × 10 × 3-mm. plates, then sintered 2 hrs. at 1400° with slow heating up and slow cooling down. Samples made with unannealed TiO_2 contracted by 17.3-22.9%, depending on the length of stay at 1400°; samples made with preliminarily annealed TiO_2 did not contract on sintering. TiO_2 was partially reduced by slow heating up to 1200° in CO in the presence of lumps of electrode C, for a length of time varying from 0.5 to 6 hrs.; depending on that length of time, the color of samples, both at the surface and in the mass, varied from bluish to black. Absence of C content in the samples was ascertained. Another batch of samples was partially reduced for different lengths of time in a stream of H_2 to a color varying from dark blue to almost black. The partial reduction resulted in samples with an O deficit ranging from 1.20 to 6.80 at.% O, corresponding to formulas from $TiO_{1.99}$ to $TiO_{1.93}$, resp., as ascertained by the gain of wt. on re-oxidation. On heating in air, thermograms of the partially reduced TiO_2 showed a large exothermal oxidation effect in the range 435-440°, and disappearance of the coloring. The exothermal effect disappeared completely on heating in the mildly reducing atm. maintained by the presence of a few lumps of C. The sp. elec. cond. σ, measured at 20°, increases with the length of the reduction, varying from 3.21 ohm^{-1} cm.$^{-1}$ for annealed TiO_2 reduced 0.5 hrs. in CO to 28.7 for unannealed and reduced 4 hrs., and from 15.9 for TiO_2 reduced 0.5 hrs. in H_2 to 93 ohm^{-1} cm.$^{-1}$ after 6 hrs.' reduction in H_2. Samples reduced in H_2 have a higher σ than those reduced in CO, and samples made with annealed TiO_2 have a higher σ than do unannealed. Except for occasional transitory anomalies, σ increases with the temp., and, as a rule, the pos. temp. coeff. of σ decreases with increasing extent of the reduction. Plots of log σ as a function of $1/T$

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are not linear, i.e. the prexponential factor A in $\sigma = A_1 e^{-\Delta E_1/2kT}$ is not temp.-independent; linearity is restored if the temp. dependence of A is taken into account by $\sigma = A_2 T^{-3/2} e^{-\Delta E_1/2kT}$. By the slopes of the tangents, the electron dissocn. energy ΔE_1, around room temp., is less than 0.2 e.v.; ΔE_1 increases with increasing A_1. The thermoelec. e.m.f. α (measured against Cu) is neg. throughout, i.e. all the TiO_2 samples are electronic conductors. Around room temp., α decreases with increasing length of reduction; for samples reduced in CO, α varies from 415 microv./degree for 0.5 hr. to 254 for 4 hrs., and for samples reduced in H_2, from 303 for 0.5 hr. to 68 for 6 hrs. With increasing length of reduction, the temp. coeff. of α passes from neg. (typical for semiconductors) to pos., which corresponds to the concn. n of electrons increasing with the temp. slower than $T^{3/2}$. No Hall effect could be detected; judging by the sensitivity of the app., the Hall const. must be smaller than 2×10^{-3} cc./coulomb, which corresponds to n greater than (3–4) $\times$ 10^{20}/cc. and a mobility u of the order of $10^{-3} - 10^{-4}$ cm.^{2}/v. sec. If the effective mass m^* of the electrons in partially reduced TiO_2 were identical with the mass m_0 of the free electron, n (calcd. from the exptl. α) would be $5 \times 10^{18} - 5 \times 10^{19}$/cc., and, with u of the order of 10–100 cm.^{2}/v. sec., σ would be of the order of 10–500 ohm^{-1} cm.$^{-1}$, in agreement with the exptl. data, but then the Hall effect should be easily detectable. This discrepancy indicates a substantially greater n, and, consequently, on account of the high σ, the effective mass m^* must of necessity be substantially greater than m_0; this, in turn, corresponds to smaller u, which accounts for the relatively low σ. The ratio m^*/m_0 can be estd. roughly with the aid of a model in which the 2 electrons around the pos. vacancy (produced by the absence of O^{--} in a lattice point) are treated as a He-like atom, with the ionization energy $E = (24 \times 4\pi/\epsilon^2)(m^*/m_0)$ e.v., where ϵ = dielec. const.; E is identified with ΔE = dissocn. energy of impurity electrons. Detns. of ϵ for the original TiO_2 and for reoxidized partially reduced TiO_2, in 1000 hertzes, gave $\epsilon = 87.5$ and 67.5, resp.; assuming, for a TiO_2 sample reduced 0.5 hrs. in CO, $\epsilon = 60$, and with the exptl. $\Delta E_2 = 0.108$ e.v., one finds $m^*/m_0 = 16$, i.e., at any rate, the effective m^* is substantially greater than m_0. "Electrons" of such high m^* are more correctly referred to as polarons, in the sense of the theory of Pekar (cf. P. and Deigen, *C.A.* **43**, 3717*d*). Values of α calcd. with the aid of the estd. m^* agree with the exptl. α only for weakly reduced TiO_2 samples. The observed correlation between A and ΔE, of the type of the Meyer-Neldel (*C.A.* **32**, 2419[2]) linear relation between log A and ΔE, can be interpreted by the known depressing effect of impurities on ϵ of TiO_2; with increasing concn. of impurity centers, i.e. with increasing A, the dielec. const. ϵ decreases, and, consequently, ΔE (which is inversely proportional to ϵ^2) increases.

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USSR/Physics - Semiconductors, Metallic — Mar/Apr 52

"Semiconductor Properties of Some Metallic Compounds," B.I. Boltaks, and V.P. Zhuze, Leningrad Phys-Tech Inst, Acad Sci USSR

"Iz Ak Nauk, Ser Fiz" Vol XVI, No 2, pp 155-168

Results of investigations of elec and thermoelec properties of Mg_3Sb_2, Mg_2Sn, Cs_3Sb and SbZn proved their semiconducting nature. Authors' exptl data on Mg_3Sb_2 and Mg_2Sn are in agreement with those obtained for Mg_3Sb_2 by N.F. Mott and H. Jones.

220T89

("The Theory of the Properties of Metals and Alloys," Oxford, 1936) and for Mg_2Sn by T.A. Kontorova ("Zhur Tekh Fiz" 18, 1948).

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BOLTAKS, B. I.

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BOLTAKS, B.

USSR/Physics - Thermoelectromotive May 52
Force of Semiconductors

"Problem of Measuring Thermoelectromotive Force
in Semiconductors," B. Boltaks

"Zhur Tekh Fiz" Vol XXII, No 5, pp 892, 893

H. K. Henisch (cf ibid. Proc. Phys. Soc, 64 B,
1014, 1951; Electr Communic, 25,2,163, 1948) re-
plies to criticism of his articles by author (cf.
Boltaks, "Zhur Tekh Fiz" 20,9, 1039, 1950).
Author repeated Henisch's expts and found Henisch's
conclusions erroneous. Letter to the editor, re-
ceived 15 Jan 52.

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Boltaks B.I.

Electrical properties of chalcopyrite. Effect of surface-treatment on the rectifying properties of the crystals. B. I. Boltaks and N. N. Tarnovskii. *Zhur. Tekh. Fiz.* 25, [illegible].—The specific elec. cond. and thermoelec. potentials were detd. for both natural and synthetic samples of $CuFeS_2$ over the temp. range 20 to 600° (one case 1200°). The rectifying action of the $CuFeS_2$-W contact was studied as a function of surface-etching treatment. F. H. R.

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USSR/Physics - Semiconductors

FD-2846

Card 1/1 Pub. 153-29/30

Author : Boltaks, B.

Title : Diffusion of Lead and Antimony in Semiconductive Alloys Bi_2Se_3 and Bi_2Te_3

Periodical : Zhur. Tekh.Fiz, 25, 767-768, 1955

Abstract : Electric properties of bismuth selenide and telluride were recently studied by P. Konorov at the Institute of Semiconductors, Acad Sci USSR. Because of the importance of these materials, the diffusion of lead and of antimony in these semiconductors were studied and experimental data on the diffusion coefficient are presented in graphs. Two US and two USSR references.

Institution :

Submitted : January 28, 1955

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BOLTAKS, B.I.

V Electrical Properties of Zinc Telluride. B. I. Boltaks, O. A. Matveev, and V. F. Savinov (*Zhur. Tekhn. Fiziki*, 1955, 25, (12), 2097–2103).—[In Russian]. ZnTe is a *p*-type semiconductor with a forbidden-energy band-width of 0·65 ± 0·05 eV., much less than expected from theory. The usual methods of prepn. of ZnTe lead to excess of Te, which gives acceptor levels ~0·2–0·3 eV. above the valence band. Doping with Se gives similar levels ~0·1 eV. above the valence band. Heating of ZnTe in O leads to the formation of acceptor levels ~0·27 eV. above the valence band. The thermo-e.m.f. (α) for specimens with compn. close to stoichiometric rises with temp. to a max. (~500 μV./°C.) at ~600° K., then falls rapidly, reversing at ~800° K. This behaviour is attributed to two competing processes: generation of holes from donors and generation of holes and electrons by the intrinsic-conduction mechanism. The extrinsic–intrinsic transition temp. is thus ~ 600° K. Similar α/temp. behaviour is found for *p*-type Co and *p*-type PbSe. The mobility of holes in ZnTe $\propto T^{-3/2}$ and is 30–50 cm.²/V.sec. The hole mass is 0·3 free electron mass. 11 ref.—A. F. B.

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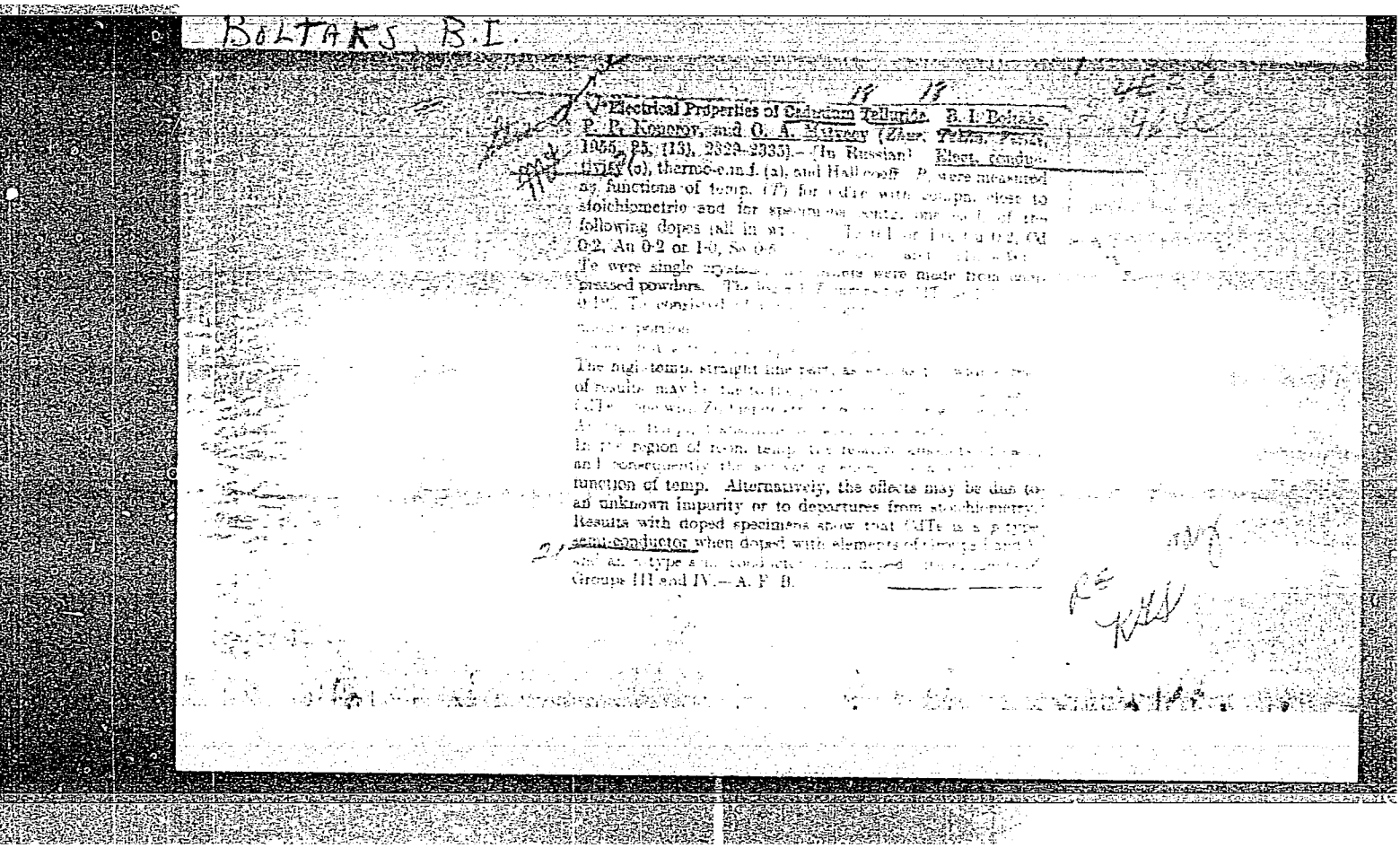

BOLTAKS, B.I.

Electrical Properties of Cadmium Telluride. B. I. Boltaks, P. P. Konorov, and O. A. Matveev (Zhur. Tekhn. Fiziki, 1955, 25, (13), 2329-2335).—[In Russian] Elect. conductivity (σ), thermo-e.m.f. (α), and Hall coeff. P, were measured as functions of temp. (T) for CdTe with compn. close to stoichiometric and for specimens contg. one each of the following dopes (all in wt. [illegible] Te 0·1 or 1·0, Cu 0·2, Cd 0·2, Au 0·2 or 1·0, Se 0·5 [illegible] Te were single crystals [illegible] were made from compressed powders. The [illegible] 0·1%. Te consisted [illegible]

[illegible] portion [illegible]

The high-temp. straight line part, as [illegible] of results may be [illegible] CdTe [illegible] In the region of room temp. [illegible] and consequently the [illegible] function of temp. Alternatively, the effects may be due to an unknown impurity or to departures from stoichiometry. Results with doped specimens show that CdTe is a p-type semi-conductor when doped with elements of Groups I and II and an n-type semi-conductor when doped with elements of Groups III and IV.—A. F. B.

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BOLTAKS, B.I.

USSR/Physics

Card 1/1 Pub. 22 - 16/49

Authors : Boltaks, B. I.

Title : About the diffusion of antimonium and tin in semi-conductive compound SbZn

Periodical : Dok. AN SSSR 100/5, 901-903, Feb 11, 1955

Abstract : Experiments with Sb and Sn are described. The experiments were conducted for the purpose of learning the dependence of diffusion coefficients of the mentioned elements in semi-conductive compounds, such as SbZn, on the temperature. Measurements of the diffusion coefficients were made by the usual method of succesively taking off layers, using for an indicator of radioactive isotopes, in the experiments mentioned, the Sb^{124} and Sn^{113} isotopes. Eight references: 7 USA and 1 USSR (1947-1954). Diagram.

Institution : Academy of Sciences of the USSR, laboratory of semi-conductors

Presented by : Academician A. F. Ioffe, October 9, 1954

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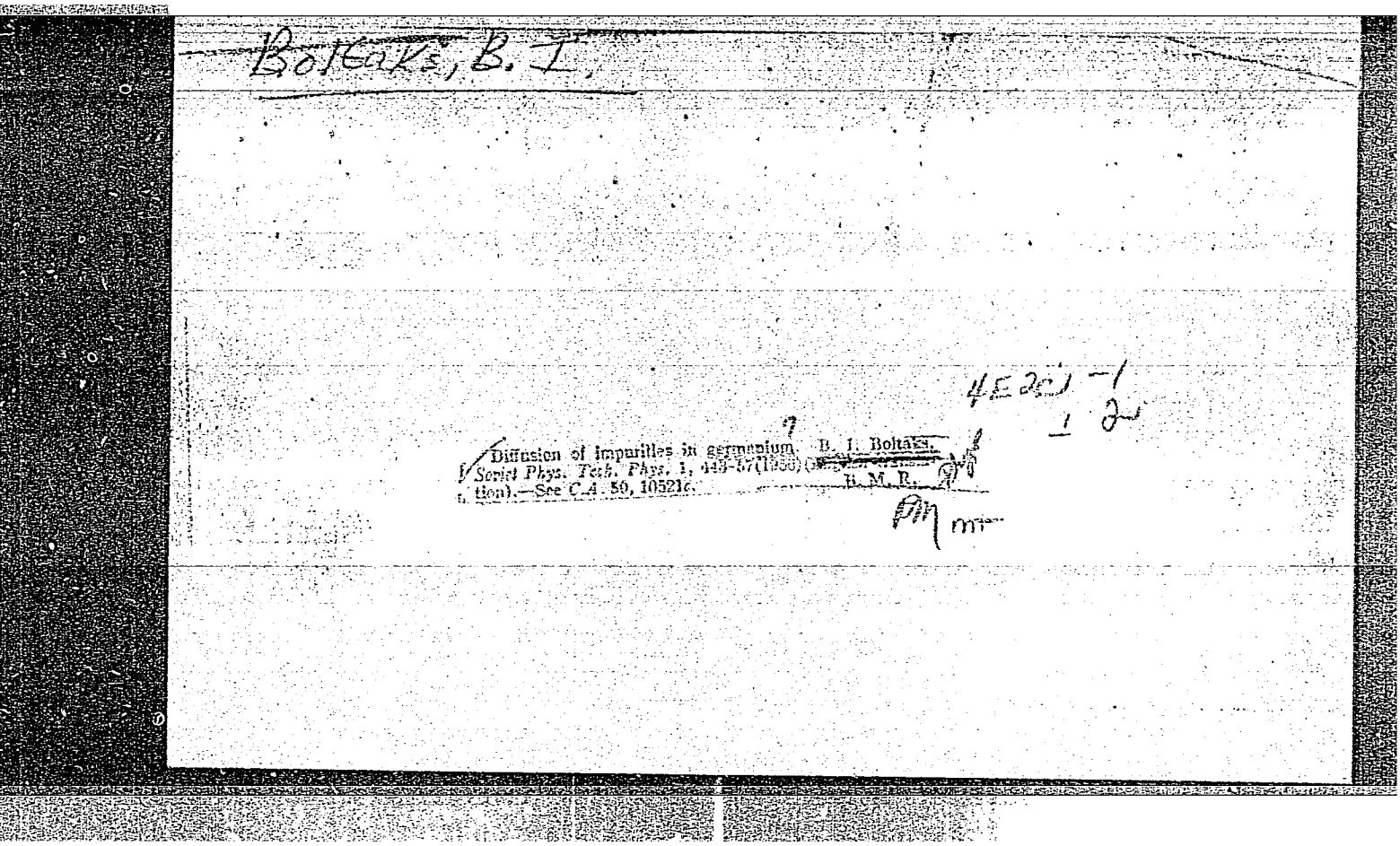

Boltaks, B. I.

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Diffusion of impurities in germanium. B. I. Boltaks. Soviet Phys. Tech. Phys. 1, 443-57(1956)([illegible] tion).—See C.A. 50, 10521c. B. M. R.

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Bolt'aKs, B.I.

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6427. THE DIFFUSION OF IMPURITIES IN GERMANIUM.
B.I.Boltaks.
Zh. Tekh. Fiz., Vol. 28, No. 2, 457-74 (1958). In Russian.

Review of the literature, both Russian and western. Discusses methods of measuring the diffusion constant; tabulates values at 800°C and gives a plot of the variations with temperature, for the impurities Li, Cu, Au, Zn, B, Ga, In, P, As, Sb and Ni. There is also a section on the solubility of these elements in germanium. J.M.Radcliffe

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BOLTAKS, B.I.

SUBJECT USSR / PHYSICS CARD 1 / 2 PA - 1673
AUTHOR BOLTAKS,B.I., MOCHOV,JU.N.
TITLE The Diffusion of Lead in Lead Telluride.
PERIODICAL Zurn.techn.fis,26,fasc.11, 2448-2450 (1956)
Issued: 10 / 1956

The investigation was carried out on monocrystalline castings of PbTe which had been produced from sublimed tellurium and the purest lead. The monocrystals were produced according to the method developed by BRIDGMAN by means of a device which was similar to that constructed by W.D.LAWSON, J.Appl. Phys. 22, 12, 1444 (1951). All PbTe-monocrystals produced here had hole-like conductivity. The samples which were cut out of the then annealed castings were carefully ground so as to be plane-parallel. A layer of lead with a thickness of from 3 to 5 micron was steamed on to one of the samples in the vacuum, whereupon the samples were subjected to a process of diffusion annealing in evacuated and soldered ampules at a temperature of from 250 to 500° C. Annealing took place in electric ovens with thermoregulators. In the course of diffusion annealing two samples, the surfaces of which (which were coated with layers of lead) touched each other, were annealed together in one ampule in each case. During heat treatment control samples were heated in a separate ampule but at the same temperature for control purposes, on which, after annealing, the electric conductivity and HALL'S constant were measured.

After these provisional results the introduction of lead into the lead telluride changes its hole-like conductivity into electronic conductivity. Therefore

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the diffusion coefficients of the lead in the PbTe were measured by the method of electron-hole transitions. The microscopic system used for purposes of observation made the immediate determination of the electron-hole transition possible. A formula for the computation of the diffusion coefficients is given. A table contains the data on the position of the electron-hole transitions, the temperature, the duration of the diffusion annealing, the concentration of the acceptor admixtures in the samples investigated here, and on the diffusion coefficients computed by means of the formula mentioned here. According to these data the diffusion coefficient in PbTe changes in accordance with the following exponential law: $D = 2{,}9.10^{-5} \exp(-0{,}6/KT)$ cm^2/sec. The low activation energy (0,6 eV) and the high diffusion velocity at temperatures which are comparatively low (compared to the melting temperature of PbTe, namely 905° C) leads us to suppose that diffusion is here realized by the shifting of positively charged lead ions in the interspaces between the nodes (like in the case of the diffusion of copper in germanium). Further investigations of this diffusion as well as of other phenomena will supply more detailed information concerning the semiconductor properties of PbTe.

INSTITUTION: Institute for Semiconductors of the Academy of Science in the USSR

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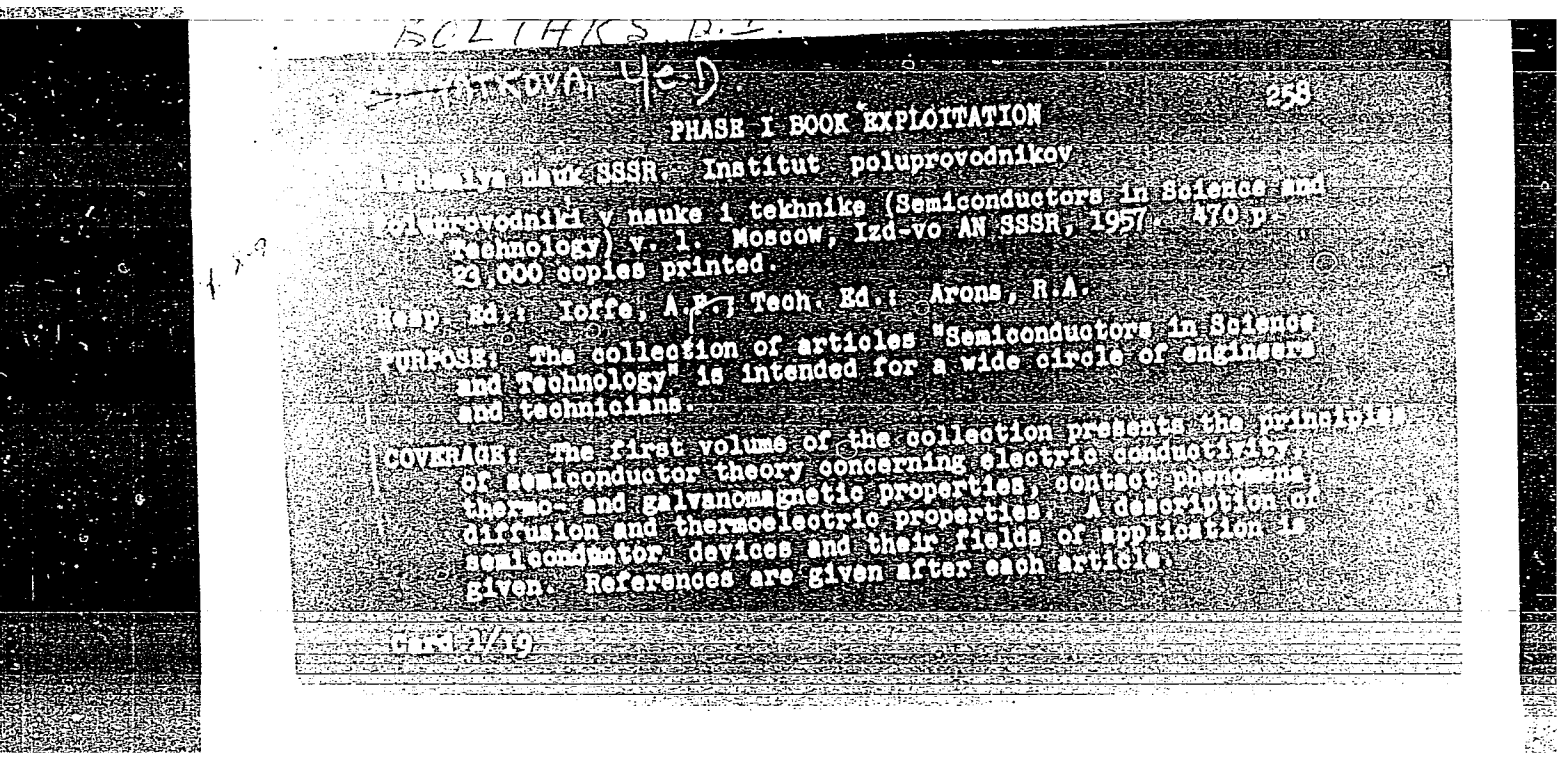

BOLTAKS, B.I.

[illegible]TKOVA, Ye.D.

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PHASE I BOOK EXPLOITATION

[illegible]demiya nauk SSSR. Institut poluprovodnikov

Poluprovodniki v nauke i tekhnike (Semiconductors in Science and Technology) v. 1. Moscow, Izd-vo AN SSSR, 1957. 470 p. 23,000 copies printed.

Resp. Ed.: Ioffe, A.F.; Tech. Ed.: Arons, R.A.

PURPOSE: The collection of articles "Semiconductors in Science and Technology" is intended for a wide circle of engineers and technicians.

COVERAGE: The first volume of the collection presents the principles of semiconductor theory concerning electric conductivity, thermo- and galvanomagnetic properties, contact phenomena, diffusion and thermoelectric properties. A description of semiconductor devices and their fields of application is given. References are given after each article.

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Semiconductors in Science and Technology

TABLE OF CONTENTS:

Foreword by Ioffe, A.F. 3

The author, who is chairman of the Semiconductor Institute, Academy of Sciences, USSR, and the responsible editor of this book, explains the aim of the present publication, namely, to fill the gap in the extremely meager literature dealing with the subject of semiconductors on an engineering level

PART I. PRINCIPLES OF SEMICONDUCTOR THEORY

Ch. I. Shalyt S.S. Electric Conductivity of Semiconductors 7

The author presents a table showing the 12 elements which exhibit semiconductor properties, grouped according to the Mendeleyev periodic system (p. 9). He give a brief description of properties of each, considering germanium the most typical and best known among them and silicon the most promising but difficult to use because of the "still unsolved problem of refining it" (p. 10). Another

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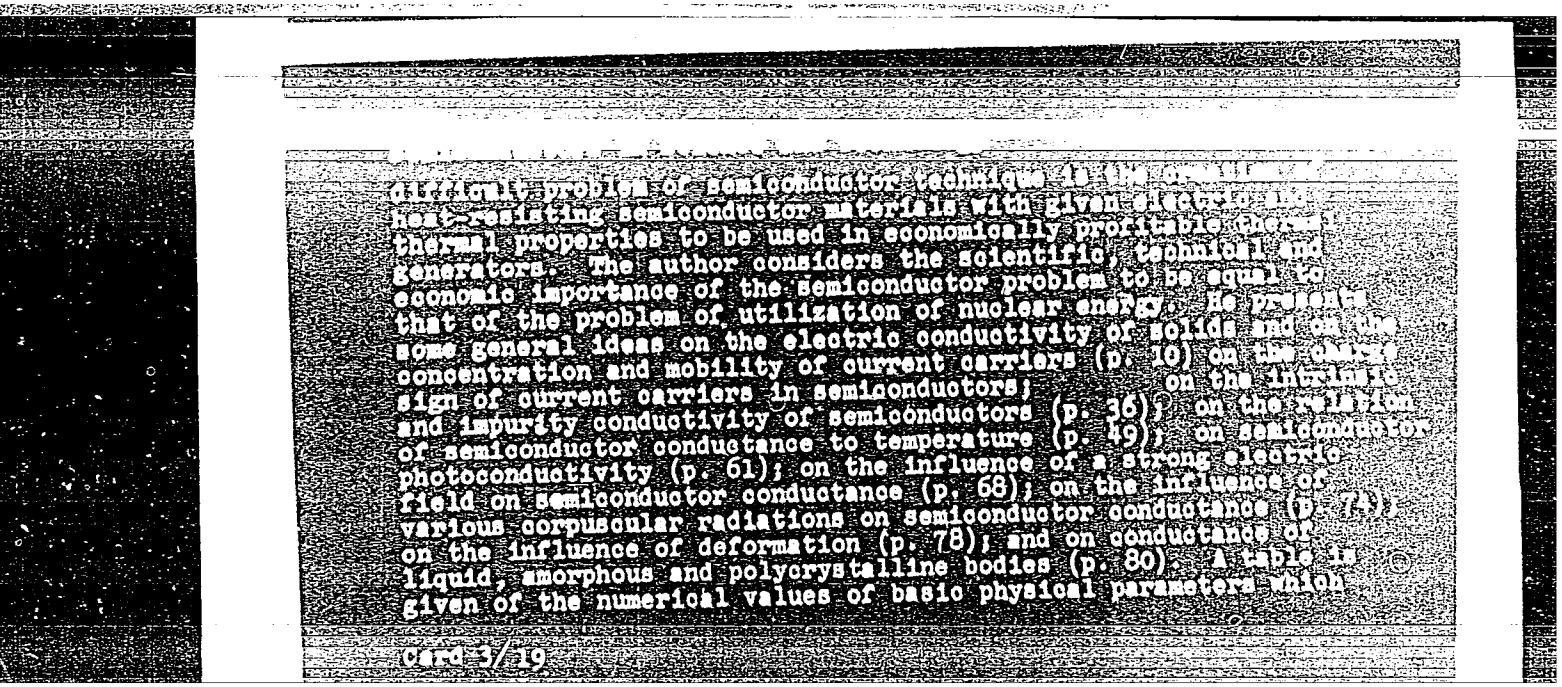

[illegible] problem of semiconductor technique [illegible] heat-resisting semiconductor materials with given [illegible] thermal properties to be used in economically profitable thermal generators. The author considers the scientific, technical and economic importance of the semiconductor problem to be equal to that of the problem of utilization of nuclear energy. He [illegible] some general ideas on the electric conductivity of solids and on the concentration and mobility of current carriers (p. 10) on the [illegible] sign of current carriers in semiconductors; on the intrinsic and impurity conductivity of semiconductors (p. 36); on the [illegible] of semiconductor conductance to temperature (p. 49); on semiconductor photoconductivity (p. 61); on the influence of a strong electric field on semiconductor conductance (p. 68); on the influence of various corpuscular radiations on semiconductor conductance (p. 74); on the influence of deformation (p. 78); and on conductance of liquid, amorphous and polycrystalline bodies (p. 80). A table is given of the numerical values of basic physical parameters which

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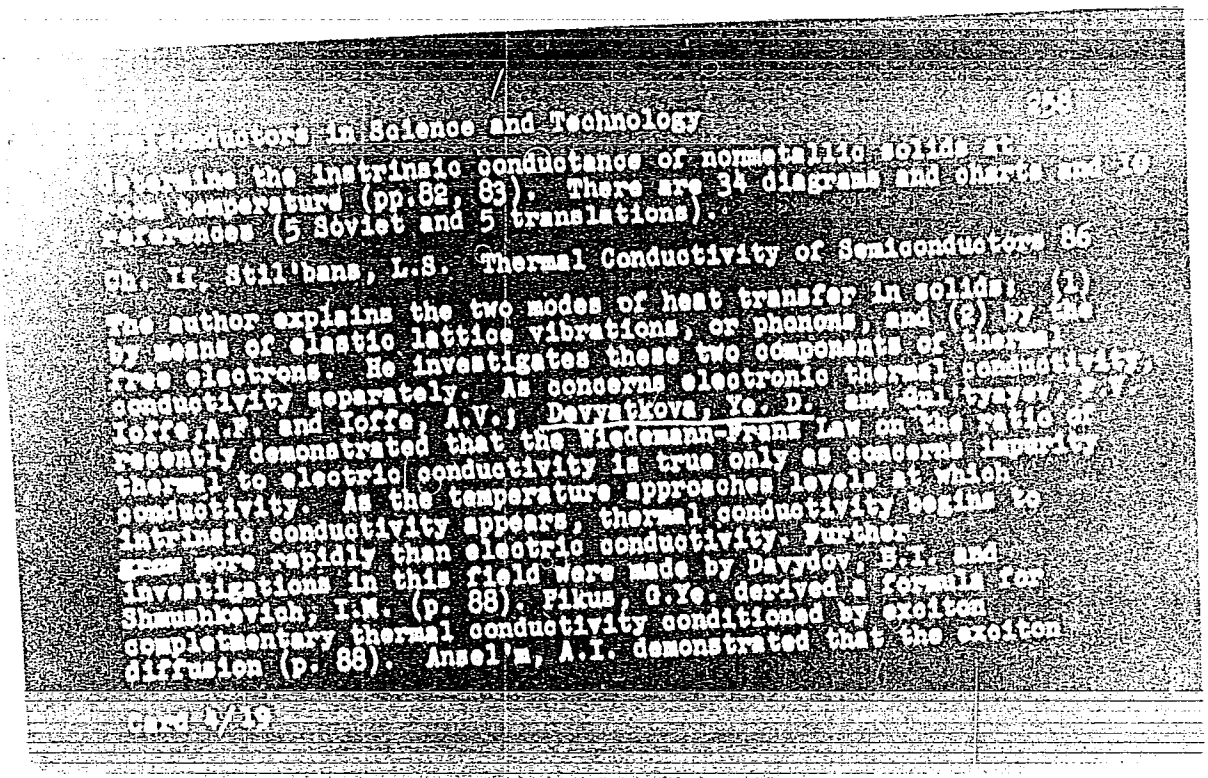

determine the instrinsic conductance of nonmetallic solids at room temperature (pp.82, 83). There are 34 diagrams and charts and 10 references (5 Soviet and 5 translations).

Ch. II. Stil'bans, L.S. Thermal Conductivity of Semiconductors 86

The author explains the two modes of heat transfer in solids: (1) by means of elastic lattice vibrations, or phonons, and (2) by the free electrons. He investigates these two components of thermal conductivity separately. As concerns electronic thermal conductivity, Ioffe, A.F. and Ioffe, A.V.; Devyatkova, Ye. D. and Gul'tyayev, P.V. recently demonstrated that the Wiedemann-Franz Law on the ratio of thermal to electric conductivity is true only as concerns impurity conductivity. As the temperature approaches levels at which intrinsic conductivity appears, thermal conductivity begins to grow more rapidly than electric conductivity. Further investigations in this field were made by Davydov, B.I. and Shmushkevich, I.M. (p. 88). Fikus, G.Ye. derived a formula for complementary thermal conductivity conditioned by exciton diffusion (p. 88). Ansel'm, A.I. demonstrated that the exciton

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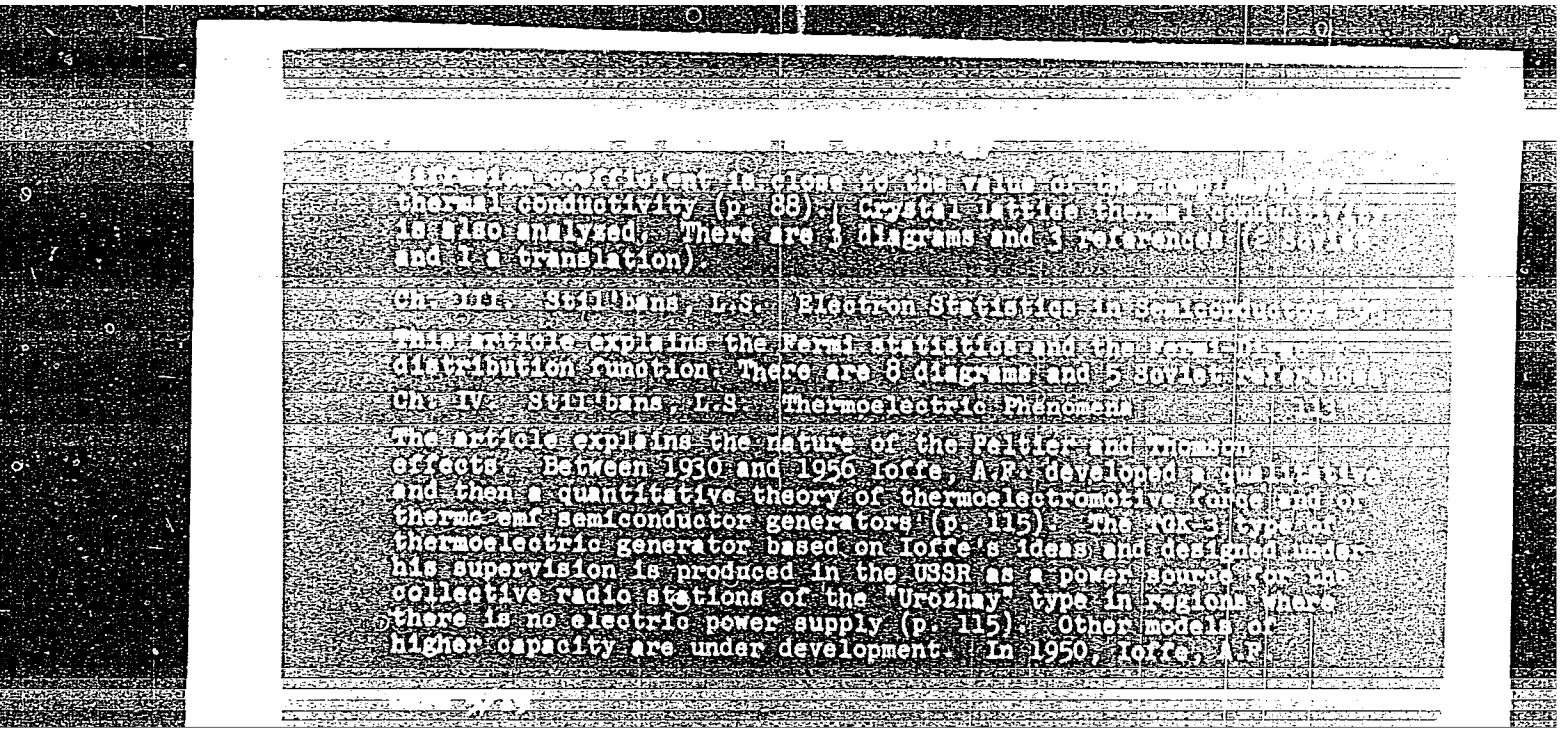

diffusion coefficient is close to the value of the complementary thermal conductivity (p. 88). Crystal lattice thermal conductivity is also analyzed. There are 3 diagrams and 3 references (2 Soviet and 1 a translation).

Ch. III. Stil'bans, L.S. Electron Statistics in Semiconductors [illegible]

This article explains the Fermi statistics and the Fermi-Dirac distribution function. There are 8 diagrams and 5 Soviet references.

Ch. IV. Stil'bans, L.S. Thermoelectric Phenomena [illegible]

The article explains the nature of the Peltier and Thomson effects. Between 1930 and 1956 Ioffe, A.F. developed a qualitative and then a quantitative theory of thermoelectromotive force and of thermo-emf semiconductor generators (p. 115). The TGK-3 type of thermoelectric generator based on Ioffe's ideas and designed under his supervision is produced in the USSR as a power source for the collective radio stations of the "Urozhay" type in regions where there is no electric power supply (p. 115). Other models of higher capacity are under development. In 1950, Ioffe, A.F.

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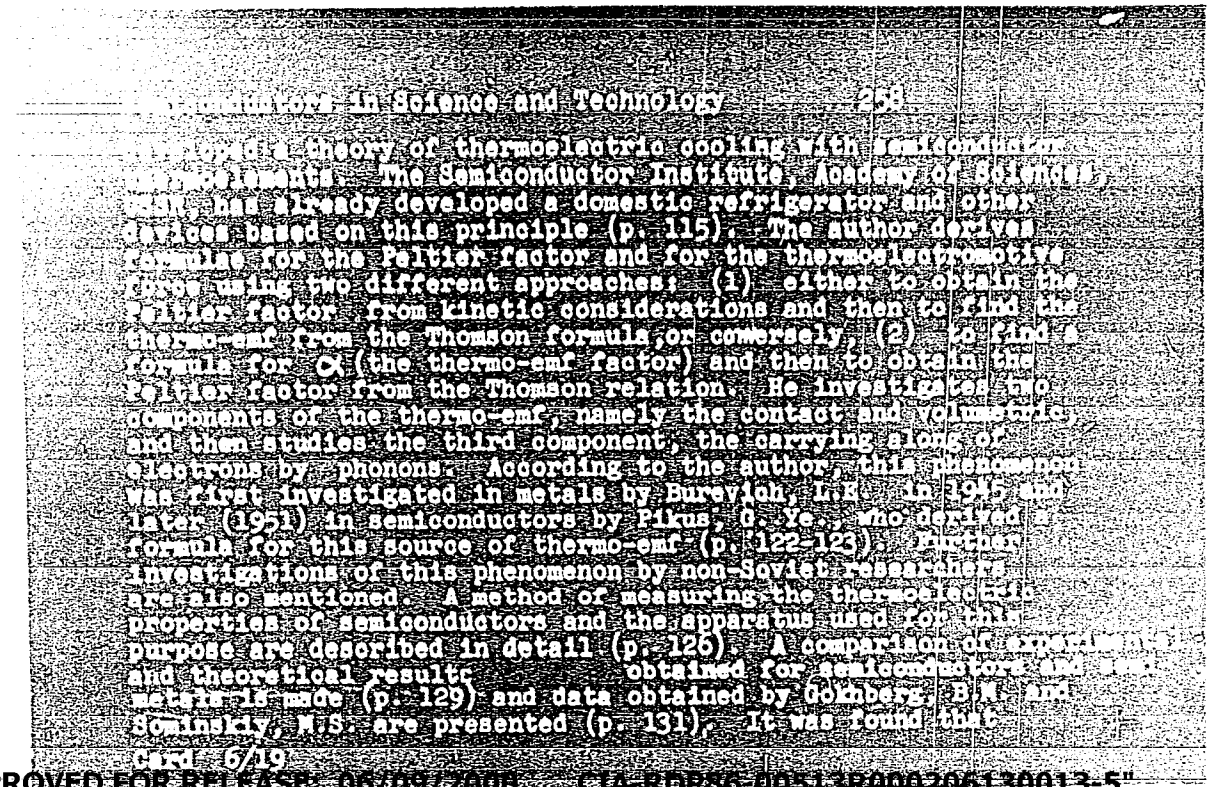

developed a theory of thermoelectric cooling with semiconductor thermoelements. The Semiconductor Institute, Academy of Sciences, USSR, has already developed a domestic refrigerator and other devices based on this principle (p. 115). The author derives formulae for the Peltier factor and for the thermoelectromotive force using two different approaches: (1) either to obtain the Peltier factor from kinetic considerations and then to find the thermo-emf from the Thomson formula, or conversely, (2) to find a formula for α (the thermo-emf factor) and then to obtain the Peltier factor from the Thomson relation. He investigates two components of the thermo-emf, namely the contact and volumetric, and then studies the third component, the carrying along of electrons by phonons. According to the author, this phenomenon was first investigated in metals by Burevich, L.E. in 1945 and later (1951) in semiconductors by Pikus, G. Ye., who derived a formula for this source of thermo-emf (p. 122-123). Further investigations of this phenomenon by non-Soviet researchers are also mentioned. A method of measuring the thermoelectric properties of semiconductors and the apparatus used for this purpose are described in detail (p. 126). A comparison of experimental and theoretical results obtained for semiconductors and semi-metals is made (p. 129) and data obtained by Gokhberg, B.M. and Sominskiy, M.S. are presented (p. 131). It was found that

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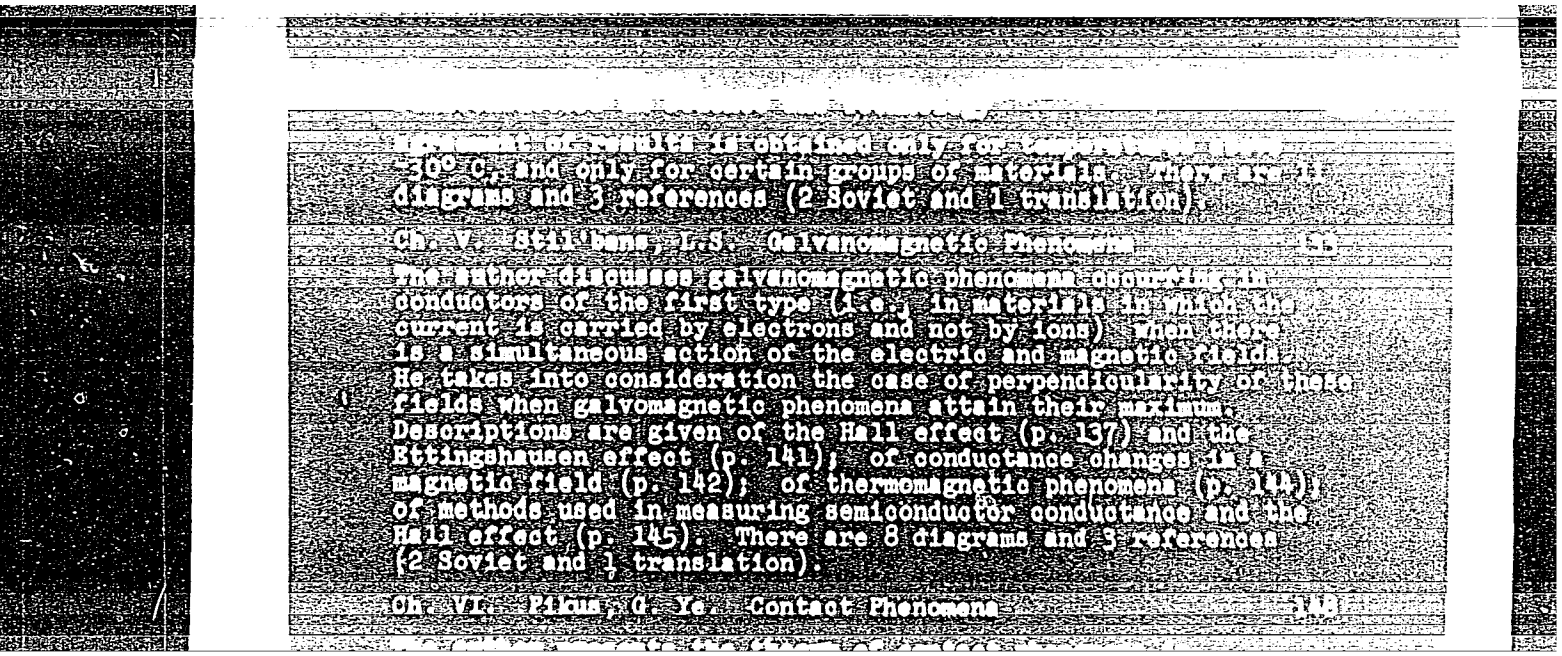

agreement of results is obtained only for temperatures above -30° C, and only for certain groups of materials. There are 11 diagrams and 3 references (2 Soviet and 1 translation).

Ch. V. Stil'bans, L.S. Galvanomagnetic Phenomena 133

The author discusses galvanomagnetic phenomena occurring in conductors of the first type (i.e., in materials in which the current is carried by electrons and not by ions) when there is a simultaneous action of the electric and magnetic fields. He takes into consideration the case of perpendicularity of these fields when galvomagnetic phenomena attain their maximum. Descriptions are given of the Hall effect (p. 137) and the Ettingshausen effect (p. 141); of conductance changes in a magnetic field (p. 142); of thermomagnetic phenomena (p. 144); of methods used in measuring semiconductor conductance and the Hall effect (p. 145). There are 8 diagrams and 3 references (2 Soviet and 1 translation).

Ch. VI. Pikus, G. Ye. Contact Phenomena 148

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[illegible]ductors and explains the principles of operation of [illegible]ductor devices: rectifier p-n diodes; p-n photocells; [illegible] junction transistors; high frequency p-n-p and n-p-n transistors; p-n-i-p and n-p-i-n transistors; point-contact transistors; channel transistors; and transistors with a high operating temperature. There are 34 diagrams and drawings and 34 references (7 Soviet, 7 translations, and 20 in English).

Ch. VII. Boltaks, B.I. Diffusion in Semiconductors 223

The author presents a review of experimental data on diffusive motion of impurities in various semiconductor materials. The following subjects are discussed: (1) Basic presentations of the mechanism of self-diffusion and hetero-diffusion in hard bodies (p. 222). This presentation results from the kinetic theory of real crystals developed by Frenkel', Ya. I. (2) Impurity diffusion in germanium and silicon (p. 226). The author, together with Sozinov, I., recently investigated the diffusion of copper in silicon for a temperature range of 800° to 1100° C. (p. 231). (3) Diffusion in sulfur, selenium and tellurium (p. 232). Nasledov, D. and Malyshev, Ye. studied the diffusion of mercury in

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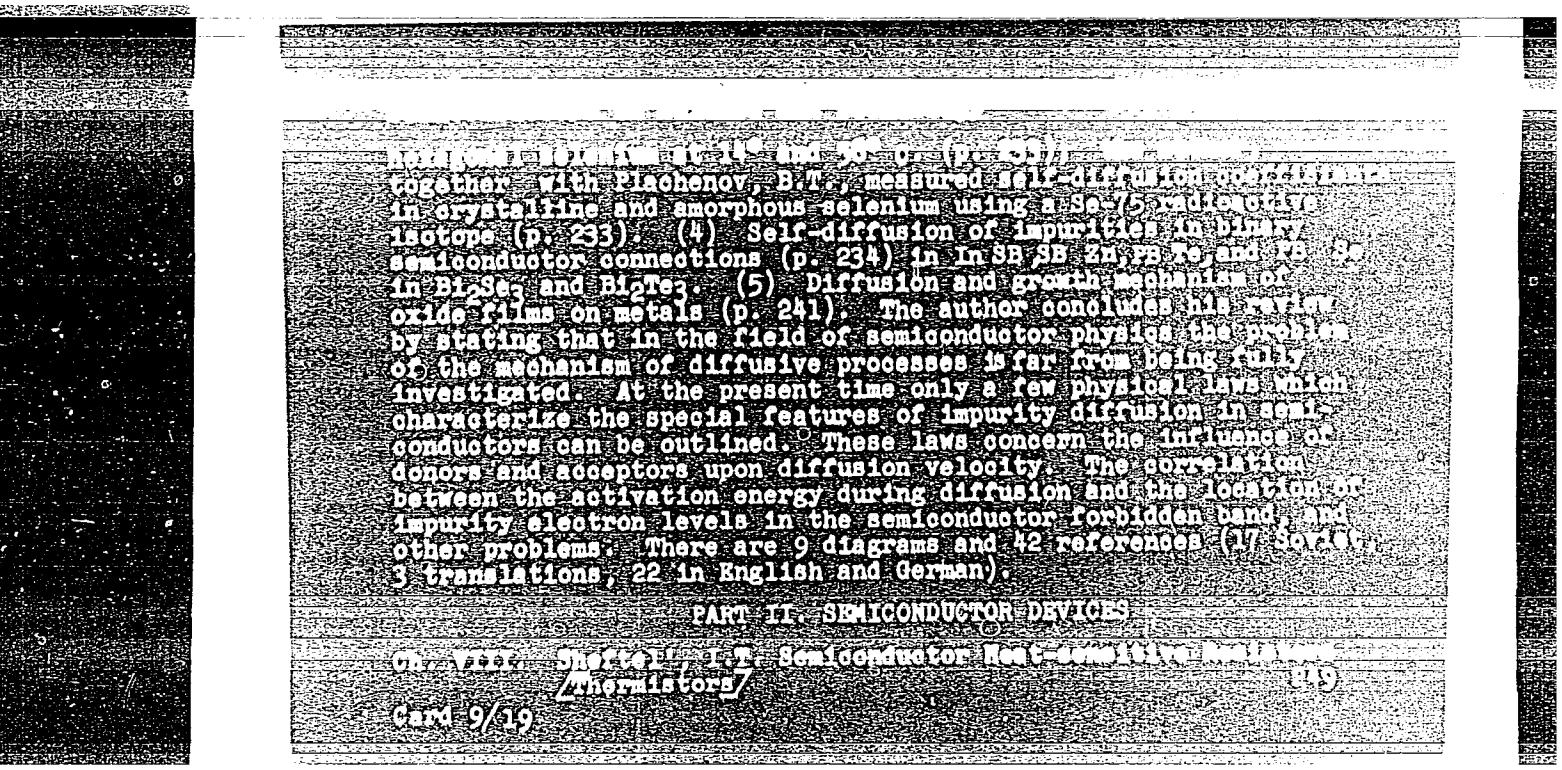

[illegible] selenium at 14° and 50° C. (p. 233). [illegible] together with Plachenov, B.T., measured self-diffusion coefficients in crystalline and amorphous selenium using a Se-75 radioactive isotope (p. 233). (4) Self-diffusion of impurities in binary semiconductor connections (p. 234) in In SB, SB Zn, PB Te, and PB Se in Bi_2Se_3 and Bi_2Te_3. (5) Diffusion and growth mechanism of oxide films on metals (p. 241). The author concludes his review by stating that in the field of semiconductor physics the problem of the mechanism of diffusive processes is far from being fully investigated. At the present time only a few physical laws which characterize the special features of impurity diffusion in semiconductors can be outlined. These laws concern the influence of donors and acceptors upon diffusion velocity. The correlation between the activation energy during diffusion and the location of impurity electron levels in the semiconductor forbidden band, and other problems. There are 9 diagrams and 42 references (17 Soviet, 3 translations, 22 in English and German).

PART II. SEMICONDUCTOR DEVICES

Ch. VIII. Sheftel', I.T. Semiconductor Heat-sensitive Resistors /Thermistors/ 249

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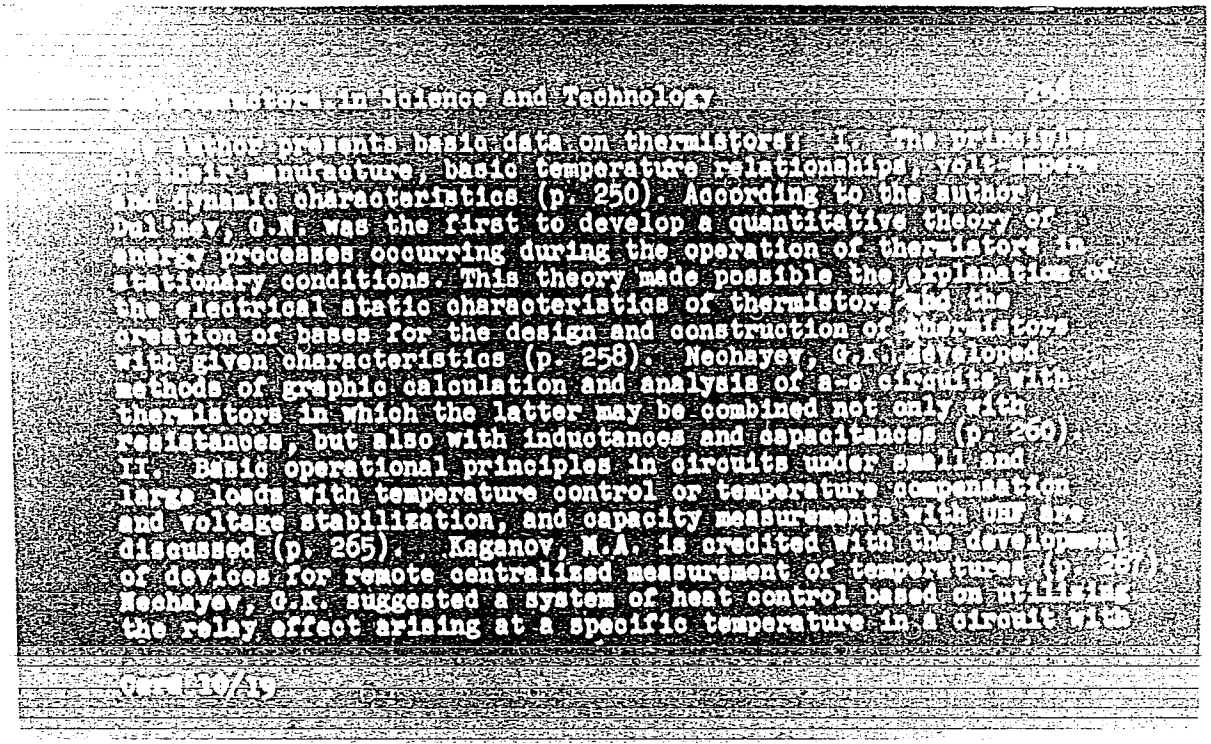

The author presents basic data on thermistors: I. The principles of their manufacture, basic temperature relationships, volt-ampere and dynamic characteristics (p. 250). According to the author, Dul'nev, G.N. was the first to develop a quantitative theory of energy processes occurring during the operation of thermistors in stationary conditions. This theory made possible the explanation of the electrical static characteristics of thermistors and the creation of bases for the design and construction of thermistors with given characteristics (p. 258). Nechayev, G.K. developed methods of graphic calculation and analysis of a-c circuits with thermistors in which the latter may be combined not only with resistances, but also with inductances and capacitances (p. 260). II. Basic operational principles in circuits under small and large loads with temperature control or temperature compensation and voltage stabilization, and capacity measurements with UHF are discussed (p. 265). Kaganov, M.A. is credited with the development of devices for remote centralized measurement of temperatures (p. 267). Nechayev, G.K. suggested a system of heat control based on utilizing the relay effect arising at a specific temperature in a circuit with

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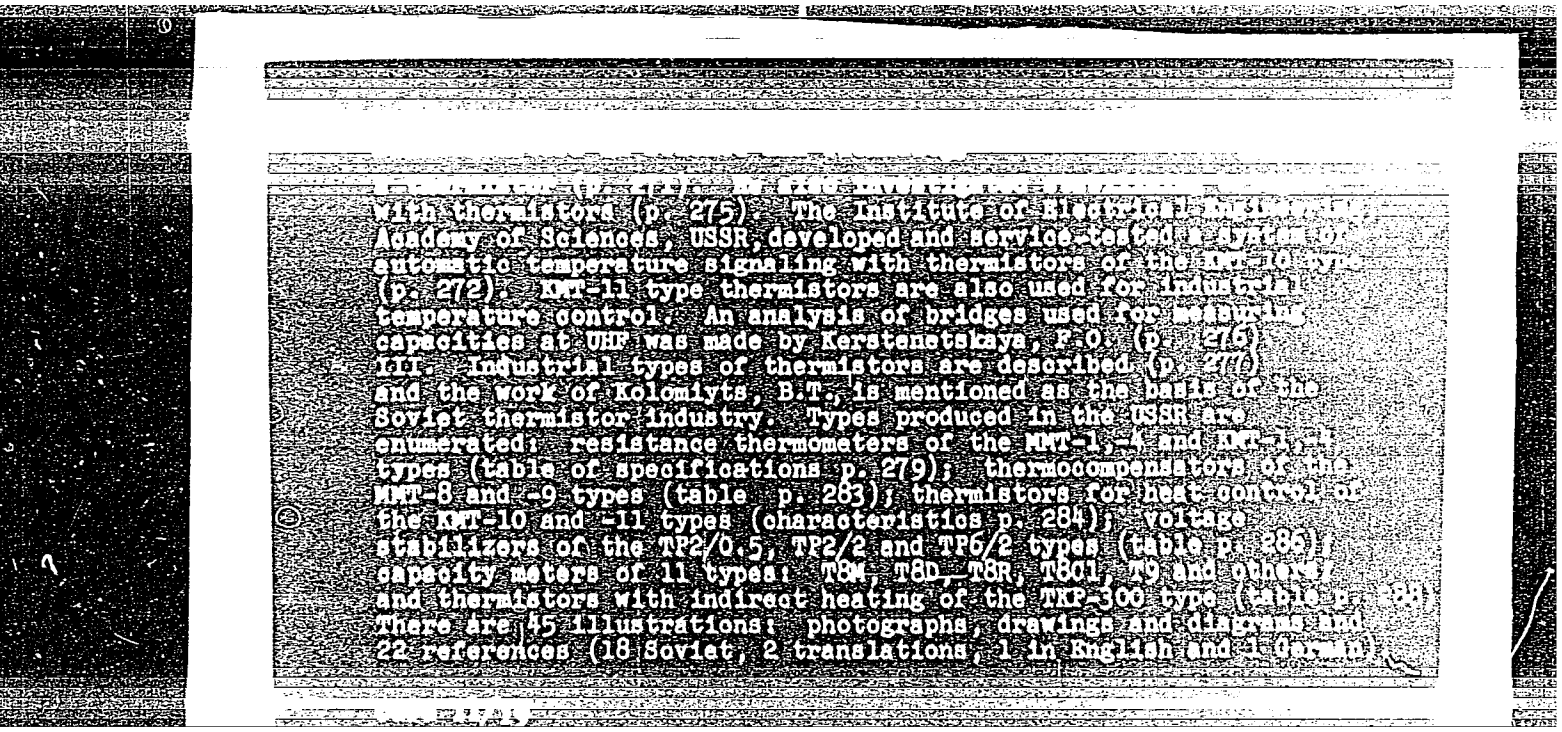

With thermistors (p. 275). The Institute of Electronics, Academy of Sciences, USSR, developed and serviced [illegible] automatic temperature signaling with thermistors of the [illegible] (p. 272). KMT-11 type thermistors are also used for industrial temperature control. An analysis of bridges used for measuring capacities at UHF was made by Kerstenstskaya, F.O. (p. 276). III. Industrial types of thermistors are described (p. 277) and the work of Kolomiyts, B.T. is mentioned as the basis of the Soviet thermistor industry. Types produced in the USSR are enumerated: resistance thermometers of the MMT-1, -4 and MMT-7 types (table of specifications p. 279); thermocompensators of the MMT-8 and -9 types (table p. 283); thermistors for heat control of the KMT-10 and -11 types (characteristics p. 284); voltage stabilizers of the TP2/0.5, TP2/2 and TP6/2 types (table p. 286); capacity meters of 11 types: T8M, T8D, T8R, T8G1, T9 and [illegible] and thermistors with indirect heating of the TKP-300 type (table p. [illegible]). There are 45 illustrations: photographs, drawings and diagrams and 22 references (18 Soviet, 2 translations, 1 in English and [illegible]).

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Ch. 9. Mirlin, D.N. Semiconductor Bolometers

The principle of operation and basic characteristics of bolometers and in particular of semiconductor bolometers (p. 300) are described. A highly-sensitive Bi-PB bolometer was recently developed by Markov, M.N., at the Physics Institute, Academy of Sciences, USSR (p. 293). In 1956 at the Semiconductor Institute, Academy of Sciences, USSR, a method of producing low-inertia Ge bolometers was developed (p. 307). Characteristics of semiconductor bolometers are presented (p. 308-313) and their application described. There are 12 illustrations: photographs and diagrams and 22 references (7 Soviet, 3 translations and 12 English and German).

Ch. 10. Pasynkov, V.V. Nonlinear Semiconductor Resistances (Varistors) 314

The author gives a brief description of symmetrical and asymmetrical varistors. Symmetrical varistors for low voltages and small currents are produced in some countries, but are not yet produced by Soviet industry (p. 315). The development of such types of varistors for various parameters is done at the Leningrad Electrical Engineering Institute im. Lenin (LETI), where small

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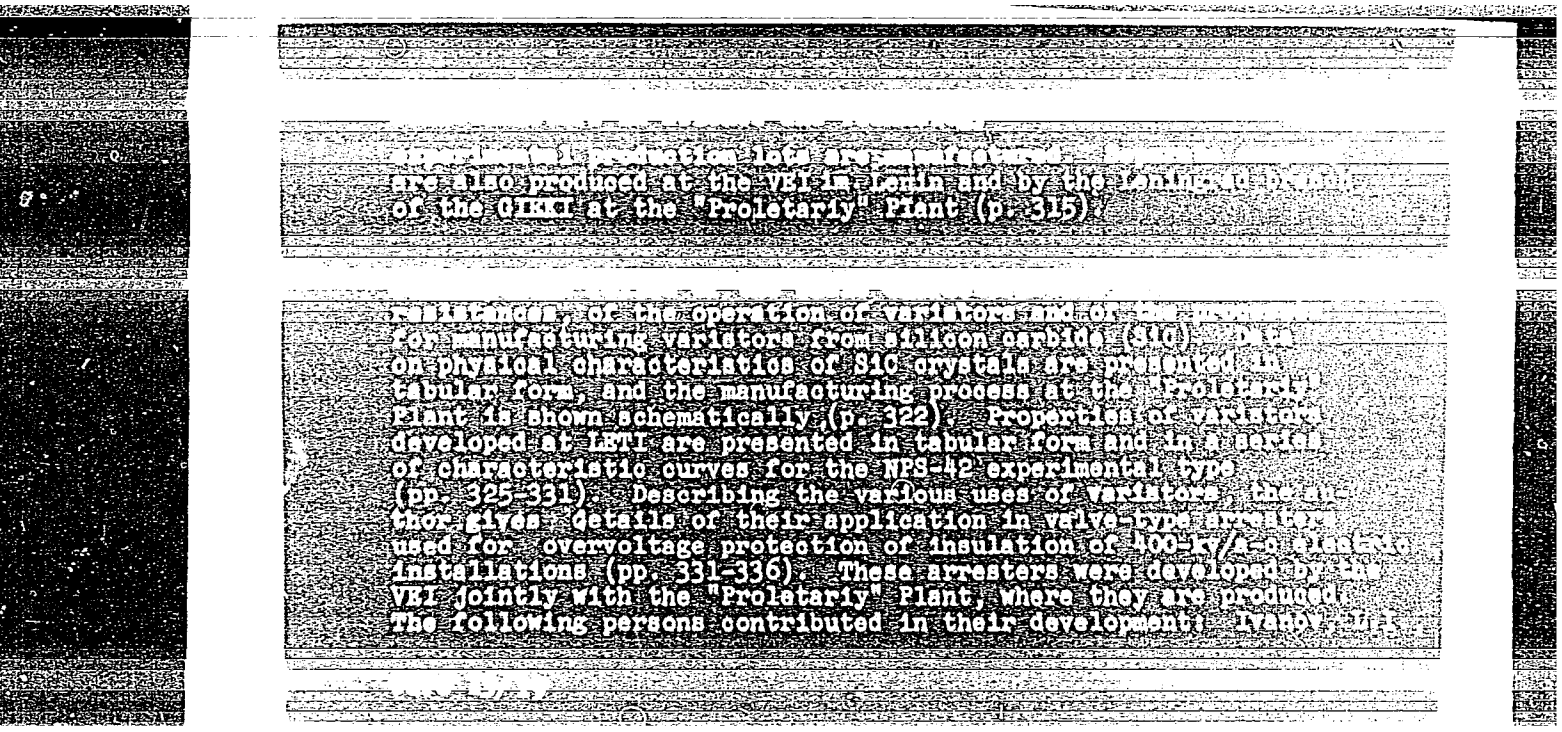

experimental production lots are manufactured. [illegible] are also produced at the VEI im. Lenin and by the Leningrad branch of the GIEKI at the "Proletariy" Plant (p. 315).

resistances, of the operation of varistors and of the [illegible] for manufacturing varistors from silicon carbide (SiC). Data on physical characteristics of SiC crystals are presented in tabular form, and the manufacturing process at the "Proletariy" Plant is shown schematically (p. 322). Properties of varistors developed at LETI are presented in tabular form and in a series of characteristic curves for the NPS-42 experimental type (pp. 325-331). Describing the various uses of varistors, the author gives details of their application in valve-type arresters used for overvoltage protection of insulation of 400-kv/a-c electric installations (pp. 331-336). These arresters were developed by the VEI jointly with the "Proletariy" Plant, where they are produced. The following persons contributed in their development: Ivanov, L.I.

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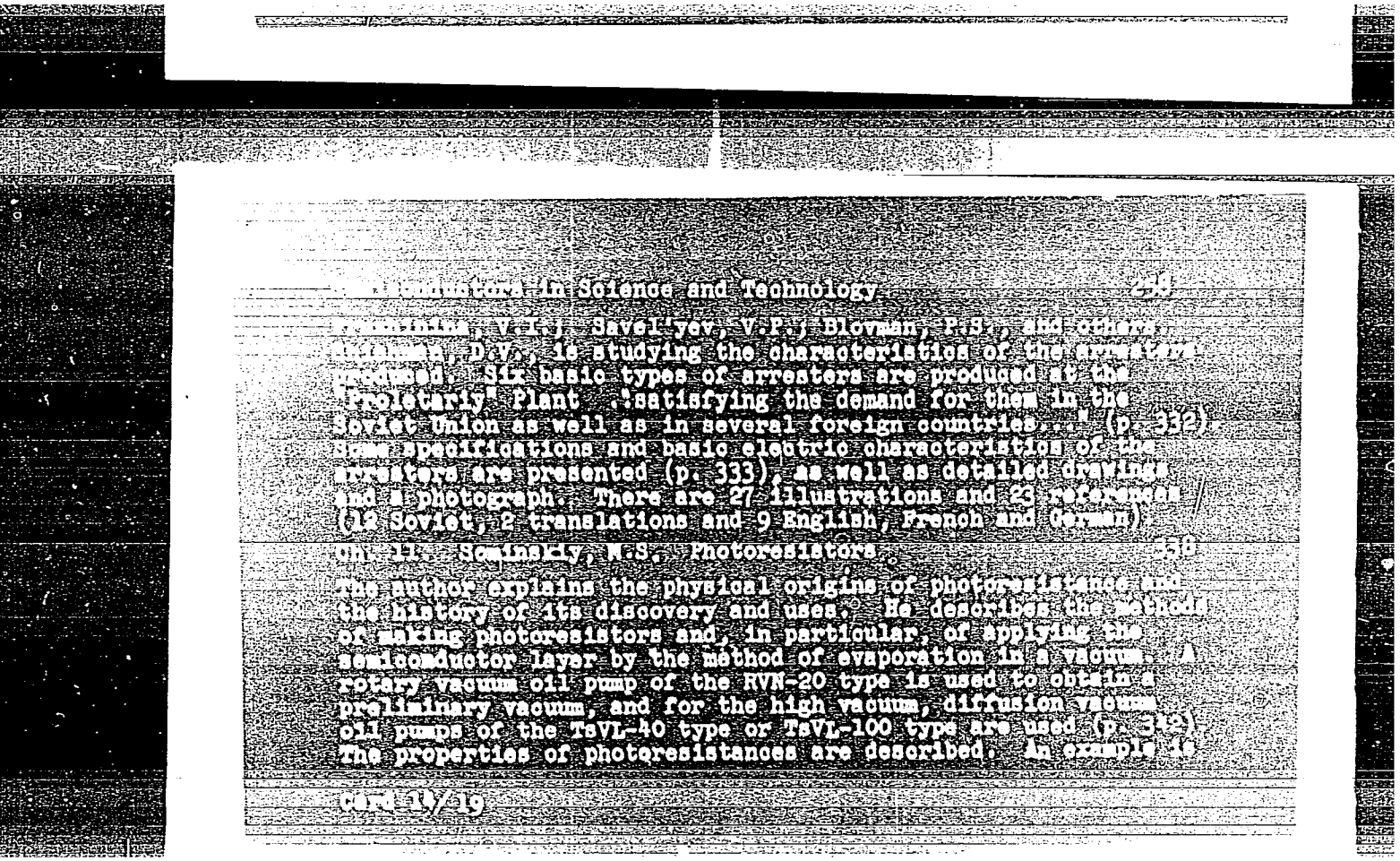

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Frankinina, V.I.; Savel'yev, V.P.; Blovman, P.S., and others. Chiakman, D.V., is studying the characteristics of the arresters produced. Six basic types of arresters are produced at the "Proletariy" Plant ..."satisfying the demand for them in the Soviet Union as well as in several foreign countries..." (p. 332). Some specifications and basic electric characteristics of the arresters are presented (p. 333), as well as detailed drawings and a photograph. There are 27 illustrations and 23 references (12 Soviet, 2 translations and 9 English, French and German).

Ch. 11. Sominskiy, M.S. Photoresistors 338

The author explains the physical origins of photoresistance and the history of its discovery and uses. He describes the methods of making photoresistors and, in particular, of applying the semiconductor layer by the method of evaporation in a vacuum. A rotary vacuum oil pump of the RVN-20 type is used to obtain a preliminary vacuum, and for the high vacuum, diffusion vacuum oil pumps of the TsVL-40 type or TsVL-100 type are used (p. 342). The properties of photoresistances are described. An example is

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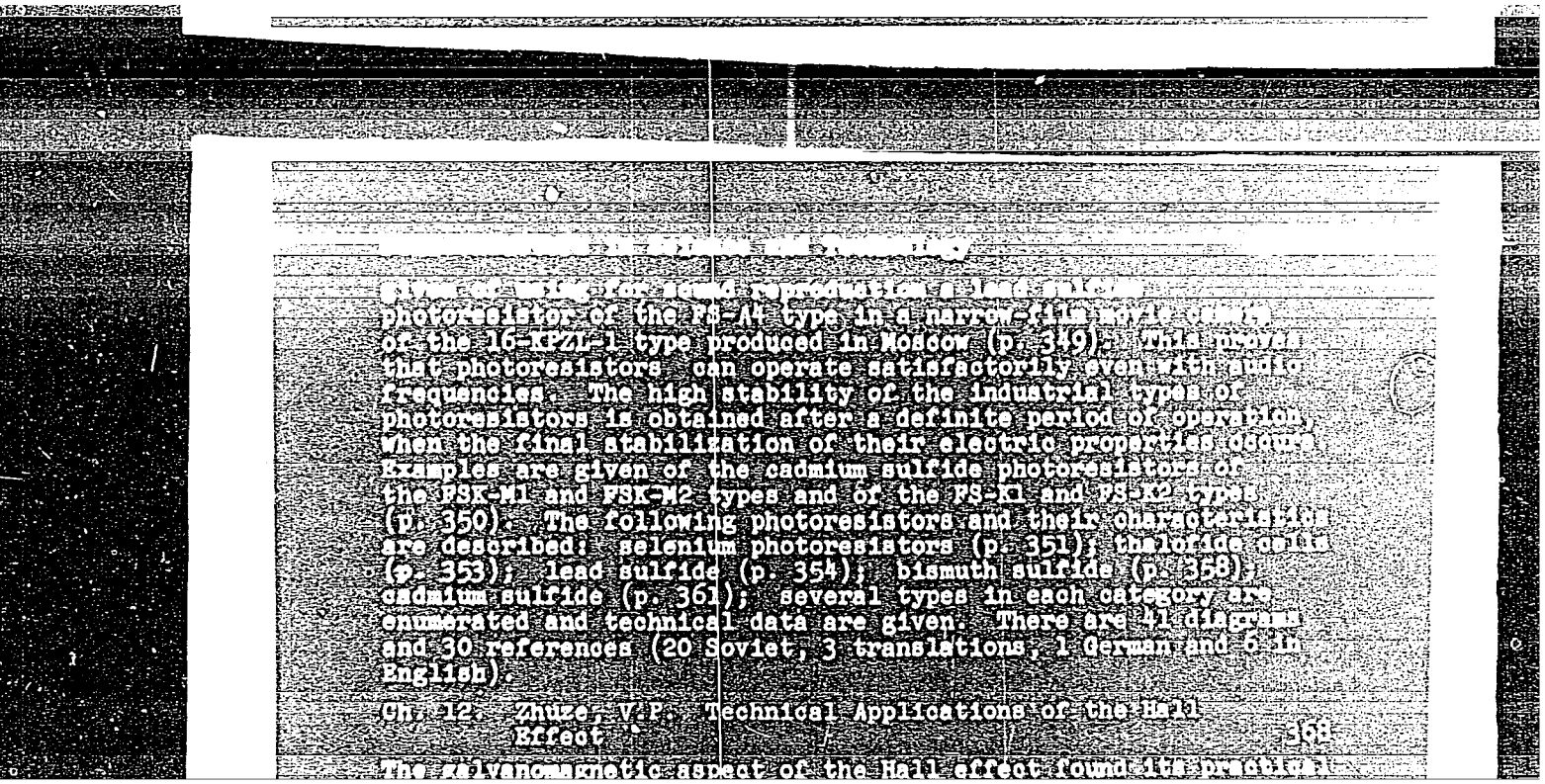

photoresistor of the FS-A1 type in a narrow-film [illegible] of the 16-KFZL-1 type produced in Moscow (p. 349). [illegible] that photoresistors can operate satisfactorily even with pulse frequencies. The high stability of the industrial types of photoresistors is obtained after a definite period of operation, when the final stabilization of their electric properties occurs. Examples are given of the cadmium sulfide photoresistors of the FSK-M1 and FSK-M2 types and of the FS-K1 and FS-K2 types (p. 350). The following photoresistors and their characteristics are described: selenium photoresistors (p. 351), thallide cells (p. 353), lead sulfide (p. 354), bismuth sulfide (p. 358), cadmium sulfide (p. 361); several types in each category are enumerated and technical data are given. There are 41 diagrams and 30 references (20 Soviet, 3 translations, 1 German and 6 in English).

Ch. 12. Zhuze, V.P., Technical Applications of the Hall Effect 368

The galvanomagnetic effect of the Hall effect found its practical

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Effect

The galvanomagnetic aspect of the Hall effect found its practical

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application with the recent development of semiconductor devices. The article includes the following: I. General information about electrical and galvanomagnetic properties of semiconductors (p. 368). II. Some information on semiconductors with high electron mobility (p. 376); data about the following semiconductors are given in detail and presented in a table of specifications: Ge, Si, HgSe, HgTe, InAs, InSb. III. Hall emf transmitter as a network element (p. 384); a table showing some characteristics of transmitters made from different semiconductors is presented (p. 389). IV. Practical development of Hall emf transmitters and various errors (p. 389); descriptions are given of the production of transmitters made with HgSe, HgTe and their solid solutions, of cutting of thin semiconductor plates with abrasive carbide discs developed at the VNIMASH in Leningrad and of the production of contacts. The author discusses the linearity of transmitter readings, errors of multiplication, and temperature

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applications of Hall emf transmitters for various technical purposes (p. 394) are discussed. [illegible] are measurements of the intensity of constant and variable

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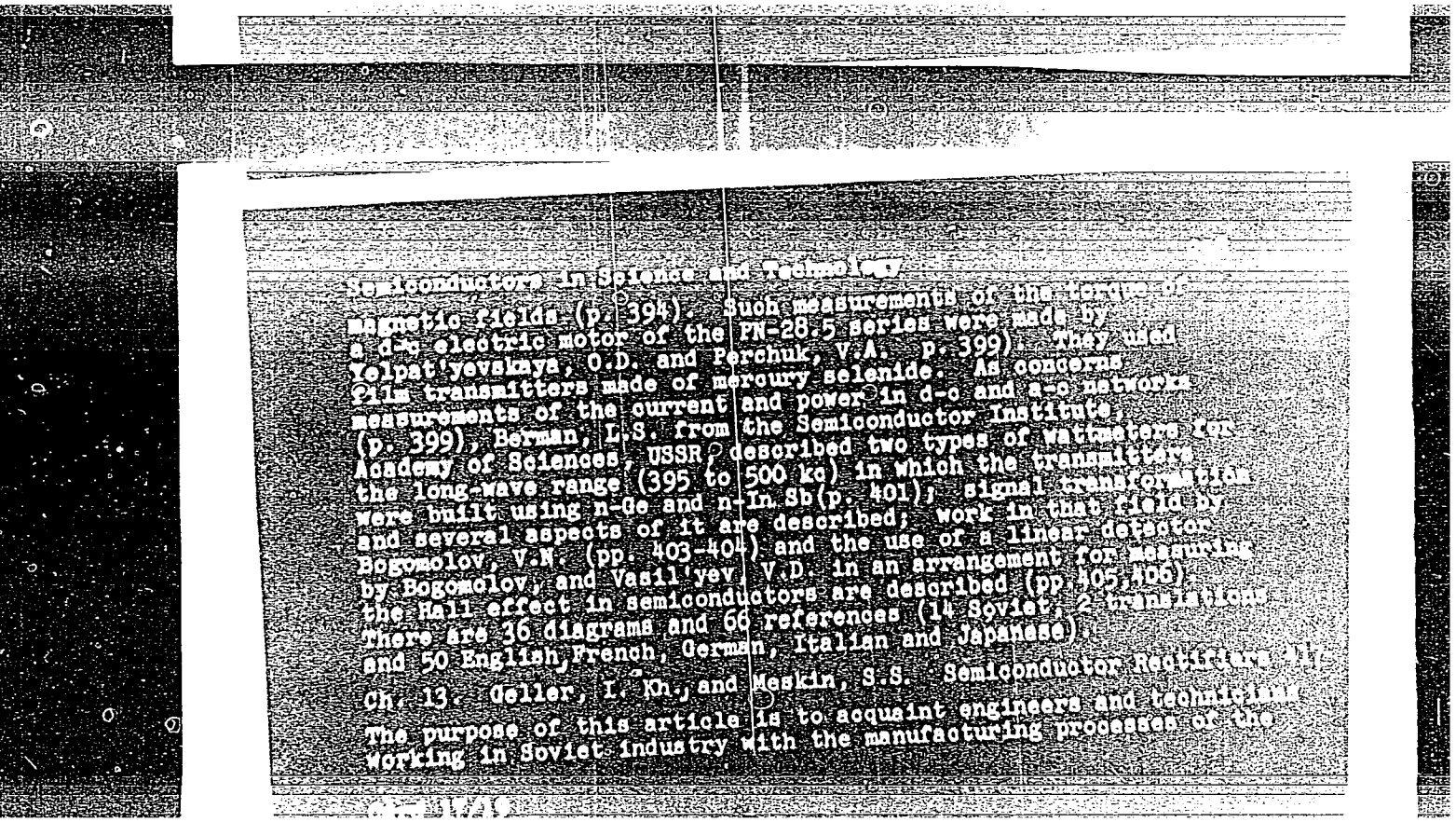

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Magnetic fields (p. 394). Such measurements of the reactive d
a d-c electric motor of the PN-28.5 series were made by
Yolpat'yevskaya, O.D. and Perchuk, V.A. (p. 399). They used
film transmitters made of mercury selenide. As concerns
measurements of the current and power in d-c and a-c networks
(p. 399), Berman, L.S. from the Semiconductor Institute,
Academy of Sciences, USSR, described two types of wattmeters (or
the long-wave range (395 to 500 kc) in which the transmitters
were built using n-Ge and n-In.Sb (p. 401); signal transformers
and several aspects of it are described; work in that field by
Bogomolov, V.N. (pp. 403-404) and the use of a linear detector
by Bogomolov, and Vasil'yev, V.D. in an arrangement for measuring
the Hall effect in semiconductors are described (pp. 405,406).
There are 36 diagrams and 66 references (14 Soviet, 2 translations
and 50 English, French, German, Italian and Japanese).

Ch. 13. Geller, I. Kh., and Meskin, S.S. Semiconductor Rectifiers

The purpose of this article is to acquaint engineers and technicians
working in Soviet industry with the manufacturing processes of the

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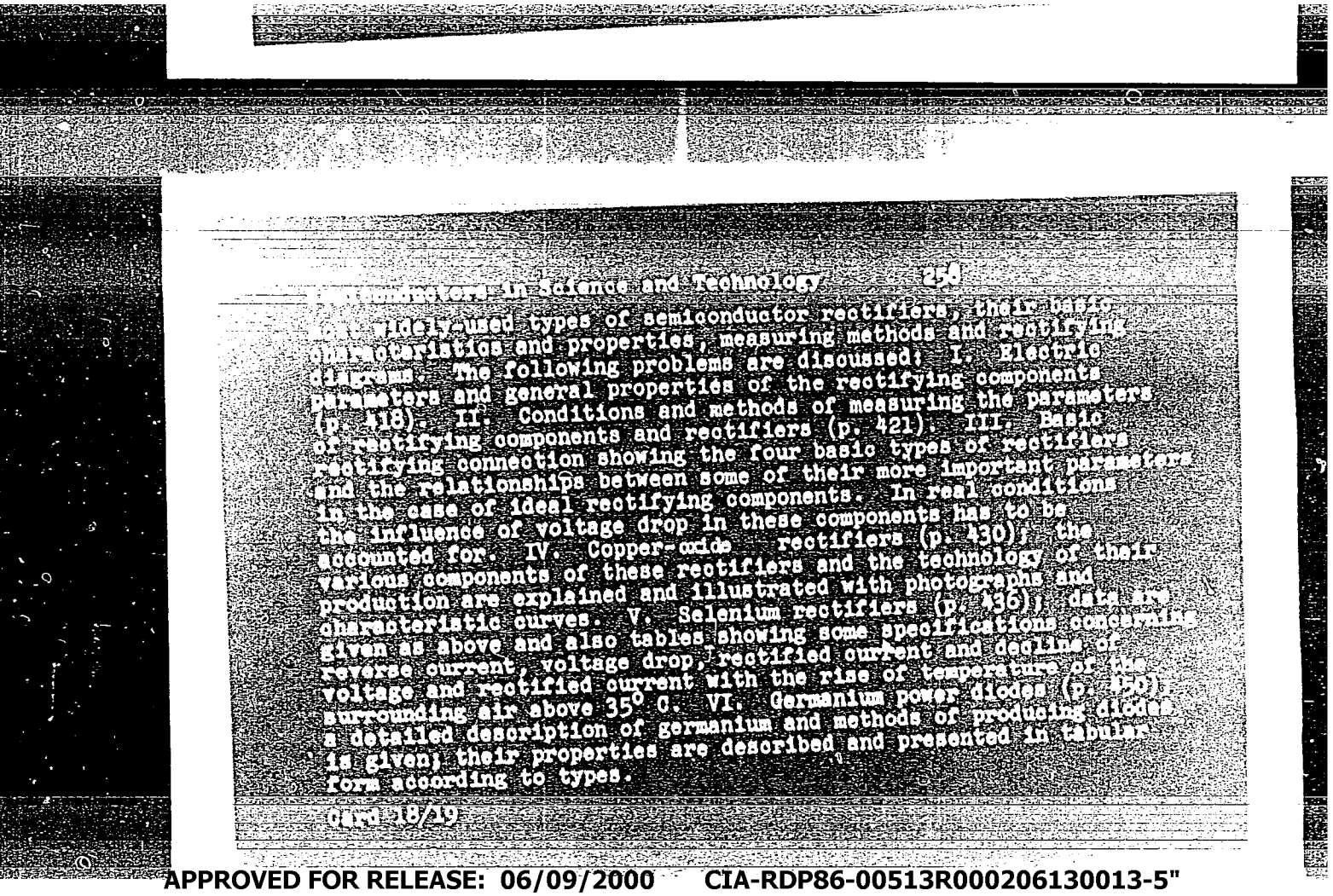

...in Science and Technology

...widely-used types of semiconductor rectifiers, their basic characteristics and properties, measuring methods and rectifying circuits. The following problems are discussed: I. Electric parameters and general properties of the rectifying components (p. 418). II. Conditions and methods of measuring the parameters of rectifying components and rectifiers (p. 421). III. Basic rectifying connection showing the four basic types of rectifiers and the relationships between some of their more important parameters in the case of ideal rectifying components. In real conditions the influence of voltage drop in these components has to be accounted for. IV. Copper-oxide rectifiers (p. 430); the various components of these rectifiers and the technology of their production are explained and illustrated with photographs and characteristic curves. V. Selenium rectifiers (p. 436); data are given as above and also tables showing some specifications concerning reverse current, voltage drop, rectified current and decline of voltage and rectified current with the rise of temperature of the surrounding air above 35° C. VI. Germanium power diodes (p. 450); a detailed description of germanium and methods of producing diodes is given; their properties are described and presented in tabular form according to types.

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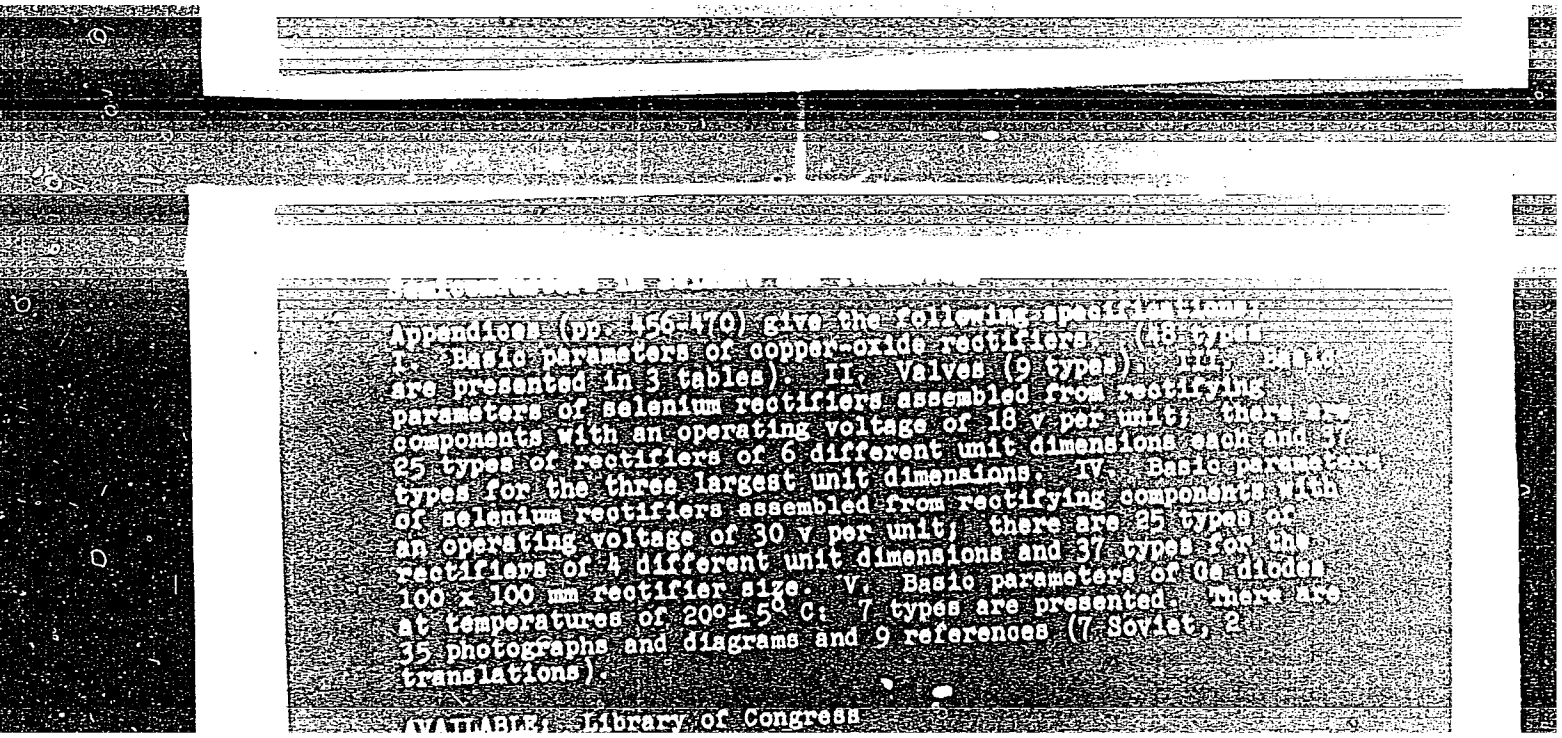

Appendix I (pp. 456-470) give the following [illegible]
I. Basic parameters of copper-oxide rectifiers (48 types)
are presented in 3 tables). II. Valves (9 types) [illegible]
parameters of selenium rectifiers assembled from rectifying
components with an operating voltage of 18 v per unit; there are
25 types of rectifiers of 6 different unit dimensions each and 7
types for the three largest unit dimensions. IV. Basic parameters
of selenium rectifiers assembled from rectifying components with
an operating voltage of 30 v per unit; there are 25 types of
rectifiers of 4 different unit dimensions and 37 types for the
100 x 100 mm rectifier size. V. Basic parameters of Ge diodes
at temperatures of 20° ± 5° C; 7 types are presented. There are
35 photographs and diagrams and 9 references (7 Soviet, 2
translations).

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SOV/137-59-1-986

Translation from: Referativnyy zhurnal. Metallurgiya, 1959, Nr 1, p 134 (USSR)

AUTHOR: Boltaks, B. I.

TITLE: On the Diffusion Coefficients of Some Impurities in Germanium (O koeffitsiyentakh diffuzii nekotorykh primesey v germanii)

PERIODICAL: V sb.: Vopr. metallurgii i fiz. poluprovodnikov. Moscow, AN SSSR, 1957, pp 121-129

ABSTRACT: The author measured the diffusion coefficients D of Sb, Pb, and Sn in single-crystal specimens of pure Ge in the 600 - 900° C range. The D values obtained for Sb satisfy the equation $D = 0.6 \exp(-2.2\ ev/kT)$. The diffusion of Sn in "n" type Ge obeys the equation: $D = 1.7 \cdot 10^{-2} \exp(-1.9\ ev/kT)$. A sharp increase in the diffusion of of Sn was observed when the low concentrations ($\sim 10^{-16}\ cm^{-3}$) of impurities were increased.

A. R.

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BOLTAKS, B.I.

SUBJECT USSR / PHYSICS CARD 1 / 2 PA - 1950
AUTHOR BOLTAKS,V.I., KULIKOV,G.S.
TITLE On the Diffusion of Indium Antimony and Tellurium in Indium-Antimonide.
PERIODICAL Žurn.techn.fis,27,fasc.1, 82-84 (1957)
Issued: 2 / 1957

The present work contains experimental data concerning the coefficients of this diffusion. The authors carried out these investigations on monolithic coarse-grained bars of InSb, which were produced from chemically pure components. The diffusion coefficients were measured by the usual method of the successive removal of layers and by using the radioactive isotopes In-114, Sb-124 and Te-127 as indicators. Diffusion-annealing was carried out at various temperatures within the interval of 300 - 500° C; the duration of this annealing varied according to temperatures from 50 to 180 hours.
A diagram illustrates the dependence lg D = f(1/T) obtained at various temperatures of diffusion annealing. Here D denotes the diffusion coefficient and T - the temperature of annealing in K. Thus it was found that the coefficients of the diffusion of indium, antimony and tellurium change in InSb crystals on the occasion of the change of temperature according to the usual exponential law. The corresponding values of the most important diffusion parameters are given. These diffusion coefficients decrease at one and the same temperature of the diffusion annealing on the occasion of transition from In to Te and further to Sb. With increasing temperature this difference decreases. The extrapolation of the data ob-

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tained into the domain of higher temperatures shows that near the melting temperature of InSb the diffusion coefficients of In, Te and Sb have one and the same value. This is obviously a consequence of the sharp decrease of the amount of the potential barriers between the nodes of the crystal lattice near melting temperature. The differences of activation energy in connection with the diffusion of In, Te and Sb in InSb are closely connected with the mechanism of the influence exercised by these elements upon the electric properties of InSb. The introduction of an admixture of tellurium into InSb turns the hole-like conductivity into an electronic conductivity, and this change is due to the replacement of pentavalent antimony in the tetrahedron-like covalent binding of InSb by hexavalent tellurium. Like antimony, tellurium must diffuse along the vacant nodes.

The interpretation of the data concerning the diffusion of In in InSb is more complicated. Indium apparently does not diffuse in InSb along the vacant nodes, but along the domains located between the nodes in form of neutral atoms of positive ions. The influence exercised by the surplus of indium upon the character of the conductivity of InSb still remains to be investigated.

INSTITUTION: Institute for Semiconductors of the Academy of Science in the Ussr, Leningrad

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Boltaks, B I.

AUTHORS: Boltaks, B. I., and Plachenov, B. T. 57-10-4/33

TITLE: A Note on Autodiffusion in Selenium (Samodiffuziya v selene).

PERIODICAL: Zhurnal Tekhn. Fiz., 1957, Vol. 27, Nr 10, pp. 2229-2231 (USSR).

ABSTRACT: Data are given for the autodiffusion coefficient of amorphous and crystalline selenium. They were obtained on the basis of experiments on "selenium for rectifiers" beeing the purest obtainable material. It is shown, that these coefficients are essentially different in the two cases and that this difference increases with a temperature rise. In the case of amorphous selenium the modification of the autodiffusion coefficient with temperature is characterized by the greater value of the factor D_0 in front of the exponential function and the greater value of the activation energy ($\Delta\varepsilon$). In the case of crystalline selen the inverse process is observed. The marked increase of the factor in front of the exponential function at the transition from crystalline to amorphous selenium is connected with an increase of the entropy accompanying this process. The difference of the activation energy is apparently caused by the different kind of processes of autodiffusion in crystalline and amorphous selenium. There are 1 table, 1 figure and 1 Slavic reference.

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A Note on Autodiffusion in Selenium. 57-10-4/33

ASSOCIATION: Institute for Semiconductors AN USSR, Leningrad (Institut poluprovodnikov AN SSSR., Leningrad).

SUBMITTED: March 4, 1957.

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"APPROVED FOR RELEASE: 06/09/2000 CIA-RDP86-00513R000206130013-5

BOLTAKS B. I.

AUTHORS: Boltaks, B. I., Tszyan Pi-khuan, 57-1-30/30

TITLE: On the Change of the Coefficient of the Thermoelectromotive Power of Tellurium with Copper and Antimony Admixtures on the Occasion of Transition from the Solid into the Liquid State (Izmeneniye koeffitsiyenta termoeds tellura s primesyami medi i sur'my pri perekhode ot tverdogo k zhidkomu sostoyaniyu)

PERIODICAL: Zhurnal Tekhnicheskoy Fiziki, 1958, Vol. 28, Nr 1, pp. 222-224 (USSR)

ABSTRACT: The experimental data obtained are given. Tellurium whichwas sublimated twice and which showed a hole - conductivity of ~2-3 $Ohm^{-1}.cm^{-1}$ and a coefficient of thermoelectromotive power of ~400 μV/degree was used as basic material on the occasion of the investigation of the thermoelectric properties of tellurium with copper admixtures. Hole-tellurium purified by means of zone recrystallization served as basic material for the investigation of the thermoelectric properties of tellurium with antimony admixtures. It can be seen from the data obtained that the coefficient of the thermoelectromotive power in the case of liquid tellurium has positive sign as to "alluмel" (alloy for thermoelements, main material nickel with Al, Mn, Si, Co) and amounts to ~40-50 μV/degrees. It does not depend on the rate of admixtures in the bar. Thermo-

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On the Change of the Coefficient of the Thermoelectromotive Power 57-1-3o/3o
of Tellurium With Copper and Antimony Admixtures on the Occasion of Transition
from the Solid into the Liquid State.

electromotive power of solid tellurium (near the melting point) depends on the presence of the admixtures. Copper admixtures considerably increase the coefficient of the thermoelectromotive power with the initial tellurium which fact is probably in connection with its donator properties in tellurium. In the range of ~ 3o-2oo°C thermoelecromotive power changes its signs and bacomes electronic. An admixture of anitmony shows less effects on the coefficient of the thermoelectromovite power of tellurium but also in this case the same tendency towards the increase of the coefficient of thermoelectromotive power in solid state near the melting point can be observed. Between solid and liquid tellurium the coefficient of thermoelectromotive power increases with the admixture of copper and antimony. Thus, the coefficient of the thermoelectromotive power between solid and liquid tellurium can be changed by means of different admixtures. There are 3 figures, 2 tables and 4 Slavic references, 2 of which are Slavic.

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On the Change of the Coefficient of the Thermoelectromotive Power of Tellurium With Copper and Antimony Admixtures and of the Occasion of Transition from the Solid into the Liquid State. 57-1-30/30

ASSOCIATION: Leningrad Polytechnical Institute imeni M.I. Kalinin (Leningradskiy politechnicheskiy institut im. M.I. Kalinina)

SUBMITTED: March 30, 1957

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"APPROVED FOR RELEASE: 06/09/2000 CIA-RDP86-00513R000206130013-5

57-28-3-33/33

AUTHORS: Boltaks, B. I., Sozinov, I. I.

TITLE: On the Diffusion of Copper in Silicon
(O diffuzii medi v kremnii)

PERIODICAL: Zhurnal Tekhnicheskoy Fiziki, 1958, Vol. 28, Nr 3, pp. 679-679 (USSR)

ABSTRACT: In a short report the authors here give the results obtained from a measurement of the coefficients of the diffusion of copper in silicon for the range of from 800 ÷ 1100°C. The measurements were performed according to the usual method of a successive removal of layers with the use of the radioactive isotope of copper - 64 as an indicator. According to the obtained data the diffusion coefficient varies from 4.10^{-7} cm^2/sec (at 807°C) to 4.10^{-6} cm^2/sec (at 1094°C). The modification of the diffusion coefficient with temperature can be expressed in the following way: $D_{Cu \rightarrow Si} = 4.10^{-2} \exp(-1,0\ eV/kT) cm^2/sec$. Thus copper in the range of from 800 to 1100°C possesses an anomalously high rate of diffusion in silicon. In comparison with germanium, however the

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diffusion coefficients at the same temperature are here 15- to 20-fold less. Such a difference is entirely justified in connection with the more solid linkage and the correspondingly much higher melting point of silicon as compared to germanium. At 875°C no influence of the constant electric field upon the diffusion of copper in silicon could be found to exist. There are 1 figure and 2 references.

ASSOCIATION: Institut poluprovodnikov AN SSSR, Leningrad (Leningrad Institute for Semiconductors, AS USSR)

SUBMITTED: August 17, 1957

1. Copper--Diffusion 2. Silicon--Analysis 3. Diffusion--Temperature factors 4. Diffusion--Electrical factors 5. Copper isotopes (Radioactive)--Applications

USCOMM-DC-60232

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